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THE AMERICAN

GAS LIGHT JOURNAL

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THE OLD YEAR AND THE NEW.

The closing day of 1890 finds us on the threshold of the last decade of the century, in the 90 years of which have been wrought many stupendous changes and many startling advances have been recorded. In fact within its cycle so far completed can be virtually traced the birth of two systems of artifical lighting that have put to rout the darkness of the prior hundred years—although he would be an extremist who would claim that the tallow-dip, the candle, and the oil lamp are not yet in the field—the latter in fact all too prominently. Still, it must be held as so that gas and electricity, in their respective fields, are the conquerors. The former holds its sway in all fields and with at least a portion of all classes. The great majority of the world's yeomanry, who must produce by their labor that which is to sustain them are the dependence of the gas maker, whereas the capitalist may incline to favor the electrician. If the ultimate cost is to be counted, estimated or obtained by the service afforded in respect of satisfaction and cheapness, the gas maker has the day and the profit, in that the greater number of people will accept and use that which appeals to them most strongly from these standpoints. But what has all this to do with our subject? The year is ended, and it is our purpose to review some of its happenings.

In the first place it gives us positive pleasure to state broadly that 1890 has been one continued record of advancement in the gas business of America. In support of this, we, in accordance with our usual custom, can state that we are in receipt of figures from 65 "test stations" in the States, and from 8 points outside of them—principally in Canada—that show a total sendout for the twelvemonth ended December 15, 1890, of 4,960 millions cubic feet. For the like period in 1889 the sendout in these same places was exactly 14.3 per cent. less. A comparison with our report in this regard for 1889 against 1888 shows that the increase for that twelvemonth on a total sendout of 2,520 millions cubic feet and 42 test points was 10.6 per cent.—a general percentage gain in favor of the past year of 3.7 per cent. What better proof can be submitted in regard to the continued, surprising and *general* expansion of the gas industry in America?

Again we are called on to make our annual apology for the general way in which the figures are submitted. To go further, some of the replies were only obtained after the submission of arguments that are chiefly used by mendicants. However, the concrete statement of all is here presented, and we are not sure but that it is just as well that the items are not put down.

As was the rule in our compilation last year, representative points not likely to be unduly favorable to the growth of the gas industry from exceptional or local causes, were taken; and the maximum single sendout in the total was 532 millions; the average of the whole being 181 millions to the test point. One other most striking feature in the compilation is the great increase in the ratio of day sendout to total sendout. We have figures respecting this latter feature from 47 of the test points, and the average of day sendout to total sendout (the latter amounts to 3,712 millions of the 4,960 millions) is 16.2 per cent. This shows very plainly to what cause a considerable portion of the increased total gain of 3.7 per cent. is chargeable. An intelligent method of putting before gas users the advantages of gas as a means of cooking food, for warm-

ing rooms, for operating gas engines, and the numberless uses to which t may be directly applied in the room of the jeweler, the shop of the small wares manufacturer, etc., has borne its natural fruit. When to this is added the fact that discriminative rates on sales of gas applied in other directions than that of lighting have been more widely adopted than in former years, the twin forces of argument and price will have been seen to have carried the day. So much for the expansion of the business in 1890.

The advances in methods of manufacture and distribution during the year have neither been numerous nor startling. The inclined retort system is, perhaps, the most novel in the first division, and the trial thereof now going on at the Laclede works will solve the question. Until the results are made known, we shall have to wait in patience, satisfied in the knowledge that the experimenters are perfectly competent to decide the matter. Water gas plants, more particularly in respect to their adoption as auxiliaries to coal gas works, have found continued favor during the year. Nor is it hard to find why, apart from any considera tion of the intrinsic merits of water gas as an illuminator, this should be so. The arrogance of labor has proved its own undoing. Retort house workers and the coal mines laborers have conspired in 1890 to advance water gas manufacture, and their's shall be the disadvantage. In the line of distribution nothing to upset the theories of old has been advanced. In fact, the experience of 1890 in this regard rather goes to show that even the natural gas companies have come to the conclusion that pressure is a very poor substitute for volume—either for the company or the consumer.

The tendency of the times is still toward lower rates, which is the most reassuring thing of all as to the permanency of our business. Ten years ago, the dollar mark was the goal. Now so many have reached that, however, and even got beyond it, that the JOURNAL is prompted to come out with the slogan of "75 cents, in the first year of the Twentieth Century." And it is not an empty claim, either.

So far as the competition with electricity is concerned, 1890 has cleared the way to many items. Arc lighting for street illumination has strengthened its position, and incandescent electric lighting has been more than ever shown to be the light of the rich. Further, the experience of Denver (Col.), Seattle (Wash.), Richmond (Va.) and numerous other smaller places, where incandescent electric lamps of various candle powers have been employed as street lighting agents, the trials having been carried over lengthy periods, goes to prove conclusively that as such an agent it is an absurd failure. The conclusion is that public street lighting must be performed by a combination of costly high power arcs, eked out by a cheap and efficient gas lamp service. The last twelvemonth proves with stronger emphasis than ever that Mr. Edison was right when he said that electricity is essentially a luxurious light; therefore, that it is the light of the rich. And as we (the poor) are largely in the majority, why, the gas man will find greater profit in catering to that majority than will his brother light purveyor in catering to the wants of the minority.

A distinctively fuel gas seems to be as far in the future as ever. Much has been said about it in the twelvemonth, but little—beyond the taking out of charters for such schemes—has been achieved. We await the result in Boston of the present more than experiment by the proprietors of the Bay State Company. If well-directed effort, backed by intelligence and money, can achieve success in the fuel gas line, then are these requisites well supplied in the gas management of the chief city of Massachusetts.

Our Associations have prospered in the twelvemonth, and give every indication that the coming year will find them increasing in merit, value, usefulness, and unity.

The only dark spots on the record of the dead year are the dates which marked the deaths of many of our craftsmen—the old, the middle-aged, and the young. A glance at the mortuary list before us sharply reminds us of those whom we have lost. It will yield no benefit to here repeat the roll of those that have gone before. Many were men whose fame in our profession was only confined by the limits of the gas world. Mourned they are most sincerely; and the memories of them that shine through the vista of the lengthening years will be the kindly lights that ever shall lead us on to do as they did.

The dead year had for us all its setbacks and disappointments, its promises fulfilled and its triumphs, and the new year opens bright with its hopes and expectations. Continued effort on the part of the fraternity is the simple talisman that will lead them on to continued success. Hence are we sure that the advances of 1890 are to be not only duplicated but exceeded in 1891.

Thanking our patrons for their generous support in the year just closed, and accepting the same as evidence that they are satisfied with our course, the JOURNAL wishes you all a happy and prosperous New Year.

The Market for Gas Securities.

The city gas share market during the week was ragged and uneven, although Consolidated more than held its own. To-day (Friday) it opened at 94½ bid, offered at 95. It is strongly held, and purchasers will likely have to make further concessions to holders. Equitable is weak and lower, although there is no particular reason therefor unless it be that the regular quarterly dividend of 2 per cent. has just been paid, and that the stock is ex-div. It is generally understood that the regular quarterly dividend of 1 per cent. will be declared soon by the Chicago Gas Company. The following records from the Stock Exchange dealings in gas shares this year will likely be found instructive:

Security.	Shares Sold.	First.	Highest.	Lowest.	Last, '90.	Last, '89.
Chicago gas.....	2,434,345	43½	65	32	34½	43½
Consolidated.....	136,099	92	107½	85	94½	91⅝
Citizens, B'klyn..	255,698	68	101	68	100	68
Equitable, N. Y..	791	119⅝	124½	117	117	125
Laclede	133,019	19	28⅝	12	16	18½
" preferred.	1,751	67	68½	50	50	—
Edison General Electric Co....	54,580	94⅝	119	65	84	—
Edison Ill. Co., New York city	200	92½	92½	92½	92½	—

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

The Key City Gas Company's Contract with Mr. Graves.

DUBUQUE, IOWA, Dec. 26, 1890.

To the Editor AMERICAN GAS LIGHT JOURNAL:

Your comments on our local controversy regarding a contract made by the Gas Company for free gas at my residence were so clear and sensible that I venture to send you a copy of the contract itself. I built and owned the gas works for 21 years, when I sold them for $140,000, and the following contract:

"Be it resolved that in consideration of the sum of one dollar to us in hand paid by J. K. Graves, and as part consideration of purchase made by us of the gas works and property of the Key City Gas Light Company, we hereby consent to and agree that all gas for ordinary purposes, including gas log in library, hereafter used in the present residence and outbuildings of said Graves, and including two street lamps in front of such residence on Fenelon Place, in the city of Dubuque, shall be free of cost, for a period not exceeding 20 years, provided said premises are occupied by said Graves or his family as their residence.

"JUNE 30, 1880. JOHN BELL, President,
"A. MCARTHUR, Secretary,
SEAL. "Key City Gas Company."

When this contract was made there were 89 burners in my residence; also a gas log and a gas stove. To-day there are but two additional burners on the premises. All of them were put in place by the Gas Company, and I use less gas to-day than I did two years ago.

Ten years have elapsed since the contract was made, and not a word of complaint ever reached me from the Gas Company until recently. Death having made a vacancy, a new President was appointed for the Gas Company.

This new official at once notified me that unless I used less gas it would be shut off.

I asked the court for an injunction. This was denied because the threat made by the Gas Company did not contemplate immediate execution; but the court announced that in case the Company took any positively decisive steps it would promptly hear my motion, and thus the matter rests.

I claim that the Gas Company has, by its new President, attempted to deliberately repudiate its contract—that it cannot do this, but must stand by it.

They know I use less gas than formerly, and that although entitled to two street lamps, I have used but one.

I tell the Gas Company it can elect which it will do—either continue in the future, as in the past, to carry out the terms and provisions of the contract, or else take back the $140,000 and the contract and surrender back the gas property. Am I not reasonable in this?

Is it not surprising the Directors and stockholders should permit the new President to involve their interests in a controversy which must surely result in injury to the Company?

Respectfully, J. K. GRAVES.

Gaseous Illuminants.

[An abstract of the second lecture of the series on this subject recently delivered before the Society of Arts, by Prof. Vivian B. Lewes. For an abstract of the first lecture, see JOURNAL, December 22, p. 877.]

The lecturer commenced by remarking that, having collected the known facts bearing on the cause of the illuminating power of flames burning under ordinary atmospheric conditions, and having seen that this luminosity is governed by the separation of nascent carbon due to the decomposition of heavy hydrocarbons present in the gas by the heat of the flame, it was evident that anything that affected the quantity of hydrocarbons present, the ease with which they decomposed, or the temperature of the flame, must also affect the luminosity; while a great deal would also depend upon the characteristic properties of the portions of the gas which act as carriers of the illuminating compounds. He then went on to explain that, in the various analyses of illuminating gases, the heavy hydrocarbons are, as a rule, expressed as "illuminants," and were formerly considered to consist mainly of ethylene. This is an idea which the researches of the last few years have shown to be totally erroneous, as, besides ethylene, there is undoubtedly present benzene, propylene, butylene and acetylene, and probably such members of the paraffine series as ethane, propane and butane, while under certain circumstances, crotonylene, terene, allylene and others, are present. The determination of the illuminants is therefore by no means the simple process one would imagine it to be from the directions given in most text-books on gas analysis.

The illuminants present in any given sample of coal gas depend upon (1) the kind of coal used, (2) the temperature at which it is distilled, and (3) the length of time the gas is in contact with the heated sides of the retort, as well as with the liquid products of the distillation.

Dealing first with the kind of coal used, Professor Lewes alluded to the paper read by Mr. G. E. Davis before the Society of Chemical Industry, in January, 1885, in which he described some experiments on the hydrocarbons in ordinary and cannel gas. The author passed large volumes of the gases through olive oil, which has the power of absorbing any hydrocarbon vapors of compounds, liquid at ordinary temperatures, which are being borne along as vapor by the carrying power of the hydrogen vapors present in the gas; and he found that illuminating gas of from 17 to 19-candle power was reduced to 8 candles, and that, on recovering the hydrocarbons from the absorbent, a very small fraction, not exceeding 2 per cent., had a boiling point below 80° C. Cannel gas having an illuminating power of 27 candles was passed through the oil, with the result that the power fell to 19 candles. The hydrocarbons, on being separated, proved to be very different: 29.9 per cent. boiling below 80° C., while 12 per cent. had a boiling point below 23° C., and probably consisted of crotonylene.

Proceeding next to consider the effect of the temperature at which the coal is distilled, the lecturer explained that, as the temperature is raised, the yield of gas from a given weight of coal is augmented; but, with the increase in volume, there is a marked decrease in the illuminating value of the gas evolved. Mr. Lewis T. Wright, in a series of experiments of which the results were laid by him before the Chemical Society in the year 1884, found that, when 4 portions of the same coal were distilled at temperatures ranging from a dull red heat to the highest temperature attainable in an iron retort, he obtained the following results as to yield and illuminating power:

Temperature.	Gas per Ton. Cubic Feet.	Illuminating Power. Candles.	Candle Power per Ton.
(1) Dull red	8,250	20.50	33,950
(2) Hotter	9,693	17.80	34,510
(3) Hotter	10,821	16.75	36,140
(4) Bright orange	12,006	15.60	37,460

The composition of the gas was as follows:

	(1)	(2)	(4)
Hydrogen	38.09	43.77	48.02
Marsh gas	42.72	34.50	30.70
Olefines	7.55	5.83	4.51
Carbon monoxide	8.72	12.50	13.96
Nitrogen	2.92	3.40	2.81

The figures in regard to the third analysis were lost, but the illuminating power shows that it is intermediate in composition between Nos. 2 and 4. From this it will be seen that, with the increase of temperature, the hydrocarbons—the olefines and the marsh gas series—gradually break up (depositing carbon in the crown of the retort), liberating hydrogen, the percentage of which steadily increases with the rise of temperature. This breaking down of the hydrocarbons does not proceed in any regular progression, bodies are built up as well as broken down during the action; the general tendency being, however, to form simpler molecules, until at last complete decomposition ensues—the higher members of the paraffine series being probably converted into paraffines and olefines of lower molecular weight. Butane, for instance, at a high temperature, is resolved into ethane and ethylene; while at a still higher temperature ethylene will form ethane and acetylene, and still further break up into methane and carbon—the methane itself being at last broken up. Indeed, the heavy hydrocarbons undergo such analytical and synthetical changes at a high temperature, that, given any member of the series, it may be resolved into carbon or hydrogen under one set of circumstances, while under others methane may become converted at high temperatures into naphthaline and acetylene. It is this fact that gives such varying composition to the illuminants present in the gas.

With regard to the effect of the length of time during which the gas is in contact with the heated sides of the retort, and with the liquid products of distillation, Professor Lewes said that, when once the gas is evolved, it should not remain longer than necessary in the retort, as, the sides being at a higher temperature than the charge, the hydrocarbons present become broken down in the way previously indicated, with deposition of carbon in the crown of the retort; while if the gas remains in contact with the tarry products of distillation, the tar will absorb a considerable quantity of the volatile hydrocarbon vapors, and seriously impair the illuminating value of the gas—the tar itself becoming much more liquid. The gas should therefore be removed from the presence of the tar before the latter has time to cool.

The lecturer went on to remark that all analyses of coal gas have hitherto been founded on the idea that the "illuminants"—*i. e.*, the heavy hydrocarbons responsible for the illuminating power—could be absorbed by fuming sulphuric acid, chlorine, or bromine. This, however, he said, is undoubtedly not the case. Mr. Wright has shown that, when coal gas has been treated with this acid, the residual gas still retains from 32 to 55 per cent. of its original luminosity; and although this may, to a certain extent, be owing to the methane, which at high temperature becomes slightly luminous, it is certain that a considerable percentage is due to the higher members of the paraffine series which are not absorbed by the acid, and which the methods of analysis usually employed utterly fail to detect. Indeed, given a gas containing any member of the paraffine series other than methane, the analytical results are not only incorrect, but misleading, as the percentages of hydrogen and methane present will be absolutely nullified by a very small quantity of the higher hydrocarbons.

In the analysis of an illuminating gas of the kind generally supplied up to a few months ago, the general process consisted in taking a measured volume of the gas over mercury, and first absorbing the sulphureted hydrogen contained in it by means of manganese dioxide impregnated with phosphoric acid; next, the carbon dioxide by potash; then the oxygen by alkaline pyrogallate; afterwards the carbon monoxide by acid cuprous chloride; and finally absorbing the "illuminants" by sulphur trioxide dissolved in Nordhausen sulphuric acid, and washing the remaining gas with potash to remove any sulphur dioxide from the acid used. The residual gas was then considered to consist of methane, hydrogen and nitrogen, and was exploded with excess of oxygen over mercury; the volume of carbon dioxide formed being estimated by absorption with potash, giving the volume of methane, while the residual gas, after the removal of the excess of oxygen by potassic pyrogallate, was looked upon as nitrogen, and the hydrogen was obtained by difference.

This method, as employed by Bunsen, gave approximately correct results; but inasmuch as the absorbents had to be introduced into the measuring eudiometer on various absorbent substances, and as it was also hampered by a mass of necessary corrections, the time taken by an analysis was enormous, and the results, when obtained, gave practically very little insight into the composition of the gas. This method, as well as the succeeding ones, were open to a grave objection, which Prof. Lewes said he would discuss later on. The first steps towards simplifying the process were made by Prof. McLeod, in his modification of the Frankland and Ward apparatus; and it was further improved upon by Mr. Thomas. The apparatus, however, still remained too ponderous, and the process too long for technical analysis, where the whole operation had to be performed in two hours at the utmost, in order that it might be of use to the gas manager or experimentalist desirous of checking the actions going on in any process. The next step was the introduction of Stead's apparatus, in which mercury was used, and in which also very convenient arrangements were made for transferring the gas to the laboratory vessels, and bringing them back to the measuring tube eudiometer. Finally, accuracy has been still more sacrificed to speed in Orsat, Meucke, and Hempel's burette, which atones, as far as possible,

for the errors introduced from the use of water instead of mercury, by the large volumes of gas which can be worked with at a time.

The processes instituted by Bunsen, and used with all forms of mercury apparatus, have several drawbacks; the chief one being that the residue left after absorption with Nordhausen acid was looked upon as hydrogen, methane and nitrogen, and that these were estimated by explosion with oxygen, and the volume of carbon dioxide formed was taken as representing the volume of methane. All researches on the composition of coal gas point to the presence of methane, and probably of higher members of the marsh gas series; while in carbureted gases they are undoubtedly present to a far higher extent. Ethane, propane and butane have all been shown to be present in small quantities; and as ethane gives double, propane three times, and butane four times its own volume of carbonic dioxide, it is evident that exploding with oxygen and taking the volume of carbon dioxide as representing marsh gas, will undoubtedly give too high results with ordinary coal gas, while with a carbureted gas it will render the whole analysis useless. Moreover, the free oxygen is next absorbed, and the remainder taken as nitrogen; and the volume of gas after absorption by Nordhausen acid, less the marsh gas and nitrogen, is taken as representing the hydrogen in the gas. The result is that the hydrogen is always far too low, not only because the volume of marsh gas is too high, but because the residual nitrogen, having to bear the brunt of all the errors of analysis throughout some seven or eight absorptions, is also nearly always too high. These palpable errors in the quantity of marsh gas and hydrogen also render worthless the calculations of the carbon and hydrogen density of the gas, on which great stress has been laid by previous observers. On the whole, therefore, it is not to be wondered at that no relation has been discovered between the carbon and hydrogen density and the illuminating value of the coal gas. With the more rapid methods of technical analysis it is evident that no explosion over water, and subsequent measurements of carbon dioxide, could give satisfactory or even approximate results, as the pressure at the moment of explosion, and the subsequent reduction of pressure, cause the water to effervesce like soda water, from the absorption and then the liberation of the carbon dioxide; and as this washes out other gases dissolved in the water, leaving an indefinite quantity of carbon dioxide in solution, any such process must be discarded.

These troubles have induced chemists to suggest several modifications in the process, some of which aim at doing away altogether with explosion. Certain of these, like the process of burning hydrogen but not methane by passage over palladium asbestos, are of great value. The last method proposed for the analysis of coal gas without explosion has been published this year. It consists in absorbing the illuminants by strong alcohol, the carbon dioxide by potash, the oxygen by porogallate of potash, the carbon monoxide by cuprous chloride, the hydrogen by alkaline solution of permanganate of potash—calling the residual gas methane and nitrogen. The objections to this process are that alcohol not only absorbs the illuminants, but also a very large percentage—say, 50 per cent.—of the methane, with considerable rapidity; that, after washing with water from the alcohol vapors, it would be useless to expect an exact determination of the carbon dioxide, as it has been mostly dissolved; and finally that, as far as Prof. Lewes' experiments have at present gone, alkaline permanganate is not a reliable absorbent for hydrogen. He is now working at the various processes of gas analysis, and checking the several methods by the analysis of known mixtures of pure hydrocarbon—work which he expects to have ready for publication next year. So far the general scheme of analysis which he is following, and which gives him the best and most instructive results, is as follows:

Two of Stead's apparatus are taken and placed with the entrance tubes end to end, and filled—one with distilled water saturated with air, and the other with clean, pure mercury. The gas to be tested is collected in one of Stead's absorbing tubes, over water, so as to be saturated; it is then transferred over mercury in the eudiometer tube of the second apparatus, and measured and passed into sodic hydrate, in order to absorb the small trace of carbon dioxide to be found in the highly purified London gas. When present in only small traces, the amount of carbon dioxide lost by water saturation cannot be detected, while a calculation is avoided. After absorption of the carbon dioxide, the gas is run into the second apparatus, and the oxygen estimated by absorption with alkaline pyrogallate, which must be strong and fresh, containing about 25 grammes of pyrogallic acid dissolved in 50 grammes of sodic hydrate in 200 c.c. of water. It is absolutely essential that the solution should be fresh, as after some time it will evolve a considerable amount of carbon monoxide. The heavy hydrocarbons have now to be estimated; and inasmuch as benzene is one of the most valuable illuminants in the coal gas, it would be of great value if any absorbent could be found that would separate the benzene and ethylene series. Unfortunately this does not exist as far as is known; the usual absorbents having the following drawbacks: (1) Nordhausen sulphuric acid, in which sulphur trioxide has been dissolved until it will solidify on cooling, absorbs both ethylene and benzene, and therefore cannot be used to separate them. (2) Fuming nitric acid is a good absorbent for both series. (3) Bromine water acts far more rapidly on ethylene than on benzene, but undoubtedly does absorb a considerable quantity of the latter if left long in contact with a mixture of the two. (4) None of the foregoing affect methane in diffused daylight. The nearest approximate result is obtained treating the gas first with strong bromine water, but not leaving it too long in contact with it, and then removing bromine vapor over sodic hydrate—the absorption being taken as the ethylene series; while the benzene is absorbed by fuming nitric acid or saturated Norhausen acid—acid fumes being removed in the sodic hydrate tube before measurement over water. After absorption with nitric acid, gas is run back into the eudiometer, and measured over water. It is then passed into an absorption tube filled with a fresh solution of ammoniacal cuprous chloride. This must not be used for more than six determinations of an ordinary coal gas containing, say, 3 to 6 per cent. of carbon monoxide, or three of a carbureted water gas, as, after much carbon monoxide has been absorbed, the solution has a tendency to again give up small quantities of the gas. The gas is now returned to the mercury eudiometer tube, and, after measurement, it is passed into an absorption tube containing ordinary paraffine oil (previously heated until everything that will distil at 100° C. has gone off), which absorbs ethane, probane, butane, and a good deal of the methane. The residue is then washed and mixed with oxygen, which has itself been analyzed, so that the percentages of nitrogen and foreign gases in it are known, and the mixture exploded over mercury. The carbon dioxide formed is estimated, and its volume plus the volume of gas absorbed by the paraffine gives the volume of gases in the methane series. A fresh portion of gas is now taken over mercury, and is exploded with excess of analyzed oxygen. The carbon dioxide is absorbed by sodic hydrate, and the oxygen by pyrogallate; and the residue will be the nitrogen—the hydrogen being determined by difference. In this way an analysis of South Metropolitan gas shows—

Illuminants	Hydrogen		47.9	
	Ethylene series (approx.)		1.5	Total Hydrocarbons. 45.6 per cent.
	Benzene " (approx.)		0.9	
	Methane series	by paraffine	9.9	
		by explosion	33.3	
	Carbon monoxide		6.0	
	Carbon dioxide		0.0	
	Oxygen		0.5	
	Nitrogen		0.0	
			100.0	

In such an analysis, the lecturer remarked, no pretence was made that the exact percentage of each illuminant was given. But the totals of the illuminants were accurate; and their rough subdivision gave a far clearer insight into the characters of gas than the more pretentious and more faulty analysis upon which it has been customany to argue. He said it must be clearly borne in mind that he only put forward this scheme of analysis to meet the need now rapidly arising for a method which would show whether ordinary coal gas enriched by cannel, coal gas carbureted with either gasoline or oil gas, or coal gas enriched by highly carbureted water gas, was being dealt with. In the first case, the ethylene and benzene series would be found well represented, while the carbon monoxide was low; in the second, the amount of hydrocarbons in the methane series would have become greater, and if oil gas had been used, a small increase in carbon monoxide might also be noticed; while the presence of carbureted water gas at once brought up the quantity of carbon monoxide, and the methane series became more important illuminants.

Professor Lewes went on to show that the light-giving values of the hydrocarbons present in coal gas vary very greatly; the illuminating power increasing very rapidly with the number of carbon atoms in the molecule. A rough idea of the value of the hydrocarbons in the various series may be obtained from the illuminating values of those experimented with by Frankland and Thorne, Knublauch, and others, as follows:

Illuminating Value of Hydrocarbons per 5 Cu. Ft. of Vapor.

Methane	5.2 candles.
Ethane	35.7 "
Propane	56.7 "
Ethylene	70.0 "
Benzene	420.0 "
Toluene	741.7 "
Naphthaline	900.0 "

The two latter were calculated from Knublauch's figures. From this it will be seen that the illuminating value of benzene and the other hydrocarbons of that series are enormously more valuable than members of the methane series; Professor Lewes thought there was little doubt that these bodies, carried as vapors by the gas, are the most important of the illuminants—their presenee being amply proved by the fact that, on compressing coal gas under a pressure of 14 atmospheres, benzene, xylene, and other members of this series, can be separated out as a liquid.

The action of the diluents in coal gas upon its illuminating power has been determined by taking ethylene, with its illuminating value of 68.5 candles, as representing the hydrocarbons in the gas, and diluting with the various diluents present. The following results were obtained by Dr. Percy Frankland:

Combustible Diluents.

Diluent.	Percentage of Ethylene.	Percentage of Diluent.	Candle Power per 5 Cu. Ft. per Hour.
Hydrogen	77.55	22.45	35.58
	68.39	31.61	49.37
	53.58	46.42	39.21
	35.47	64.53	30.85
	26.08	73.92	22.84
	13.37	86.63	6.72
	10.00	90.00	Nil.
Carbon monoxide	81.65	18.35	55.27
	67.75	32.25	47.73
	46.30	53.70	23.09
	37.94	62.06	26.52
	28.73	71.27	13.36
	23.89	76.11	6.56
	20.00	80.00	Nil.
Methane	85.67	14.33	57.91
	69.09	30.91	47.88
	57.74	42.26	40.42
	35.90	64.10	33.17
	13.00	87.00	19.35
	7.87	92.13	17.59

These results show that, with the combustible diluents, hydrogen reduces the illuminating power least with large quantities of the hydrocarbons; but that marsh gas is preferable when in excess, as with low percentages of the illuminant, especially when burnt at a high temperature, marsh gas itself becomes a feeble illuminating agent. This is due to the fact that although, when the marsh gas or methane burns at ordinary temperatures, it is non-luminous, at a high temperature some of it is broken up into acetylene, which gives it distinct luminosity. Carbon moxoxide is the most injurious of the combustible diluents; 80 per cent. mixed with ethyiene rendering it non-luminous—a result which would require 90 per cent. of hydrogen to bring about.

The influence of incombustible diluents on the illuminating power of flames containing hydrocarbons has been also determined, with the following result:

Incombustible Diluents.

Diluent.	Percentage of Ethylene.	Percentage of Diluent.	Candle Power per 5 Cu. Ft. of Gas.
Carbon dioxide	93.68	6.32	55.52
	90.59	9.41	51.81
	89.03	10.97	49.98
	81.73	18.27	42.81
	70.75	29.25	33.23
	64.14	35.85	26.52
	52.94	47.06	14.72
	45.61	54.39	7.49
	40.00	60.00	0.60
Nitrogen	82.69	15.31	51·96
	71.12	28.88	39.58
	59.93	40.07	29.64
	47.08	52.92	20.81
	36.24	63.76	11.82
	28.81	71.19	7.20
Oxygen	82.57	17.43	70 93
	80.67	19.33	72.53
	75.51	24.49	74.19
	68.50	31.50	71.17
	60.69	39.31	explosion.
Air	79.68	20.32	54.45
	67.15	32.85	45.84
	55.92	44.08	37.16
	42.69	57.31	27.78
	33.91	66.09	16.22
	22.31	77.69	0.61
	13.31	86.69	explosion.

Moisture, when present to the extent of 2 per cent. (the proportion present in coal gas saturated at 20° C. and 760 mm.) with ethylene, reduces the illuminating power 3.6 per cent., or in coal gas 3.3 per cent. Of the inert or non-combustible diluents, therefore, carbon dioxide is the most injurious; while atmospheric air is the least harmful. Wurtz has also determined the loss of light incidental to the addition of air to coal gas; and he gives the following results:

Added Air.	Percentage Loss of Light.
3.00	15.69
4.96	53.83
11.71	41.46
16.18	57.53
25.00	84.00

The addition of oxygen to gases rich in hydrocarbons causes an increase in the illuminating power up to a certain point, by raising the temperature of the flame by burning up the hydrogen of the hydrocarbons, and rendering the carbon incandescent, without diluting the flame with nitrogen to the extent that would have been necessary had air been used for the purpose. The effect of such gases as hydrogen, marsh gas, and carbon monoxide is simply to dilute the flame, and, by separating the molecules of the hydrocarbons, to make them more difficult to decompose; whereas such bodies as carbon dioxide, nitrogen, air and water vapor not only dilute but also cool the flame, as they do not add to the heat by any action of their own, and have to be heated up to the same temperature as the flame itself. Rosette determined the temperature of a gas flame diluted with air, nitrogen and carbon dioxide respectively, and found that it was least with the last named gas, and highest with air—a result which agrees with Dr. Frankland's determination of illuminating power. His figures are as follows:

Volumes Taken.			Temperature.	
Gas.	Diluent.	Air.	Nitrogen.	Carbon Dioxide.
1 vol.	1 vol.	——	1,180° C.	1,100° C.
1 vol.	2 vol.	1,260° C.	1,150° C.	880° C.
1 vol.	3 vol.	1,116° C.	1,040° C.	780° C.

Electric Lighting Progress in London.

By Mr. F. Baily, Assoc. M. Inst. C. E.

The last paper on electric lighting read before the Society was by Mr. R. E. B. Compton, in 1888, when he placed before you some of the difficulties and obstacles which were retarding the progress of electric lighting. The rapid progress made within the last 18 months will, however, show that these difficulties have to a great extent, been removed by a number of supply companies having obtained Parliamentary powers to lay mains within certain specified areas into which London has been divided. I propose, therefore, to place before you, in general terms, the work done and in progress by the various companies, as the time at my disposal will not permit me to give minute details of generating stations and systems.

Although the development of electric lighting has been so rapid within the last 10 years, it must not be forgotten that the arc light was shown at the Royal Institution tn 1809, and remained a scientific curiosity until 1848, when Staite gave a public exhibition of his arc lamp from the portico of the National Gallery in Trafalgar square. The *Illustrated London News* of that time contains a drawing of the scene, with the following remarks: "The electric light possesses no novelty. Year after year it has been exhibited at every course of philosophical lectures since the time of Sir Humphrey Davy, and therefore really its practicability forms the whole subject for consideration." The electrical energy for this light was obtained from a primary battery; and it is probable that the practicability of this method of obtaining light will continue to remain a subject for remote consideration. At this time, the seed sown by Faraday's discovery, in 1831, of electro-magnetic induction, had fallen on fruitful soil; and the wonderful dynamos of to-day form a suitable monument to his genius.

You will see, therefore, that electric lighting commenced its career in London, and London ought, therefore, to show the greatest progress. The incandescent lamp, in some form or another, is mentioned almost yearly from 1836 onwards, and I propose at once to jump to the period when Swan in England and Edison in America brought out the present form of lamp.

Through the kindness of Mr. J. W. Swan, I have the honor to show you the first lamp he made. It is to be hoped that this lamp will eventually come under the care of one of our great museums, in order that future ages may recognize the genius of Mr. Swan.

I have also to thank Mr. Sydney Morse for the loan of another valuable historical lamp, this being the first lamp constructed by Edison.

Time does not permit me to trace the history of the incandescent lamp, or the extraordinary development of its manufacture. Nothing could have been done practically without the mercury pump, and we ought,

therefore, to place the inventor, Dr. Sprengel, in a high position on our records of pioneers.

Turning to the record of general distribution of the electric light in London, you all know that practically nothing was done under the Act of 1882, but private enterprise provided fields for encouraging the efforts of the electrical engineer, and foremost amongst these must be mentioned the Grosvenor Gallery station, which did such good service in making the capabilities of the light known, and in proving the absolute necessity that existed for it; for however defective the supply may have been towards the close of the existence of the station (owing to the plant being overloaded), we owe a debt of gratitude to Lord Crawford for his energetic support to this enterprise, and to those who worked so hard to bring it to perfection. Mr. Ferranti, and those who worked with him at the Grosvenor, laid the foundation stone of a satisfactory transformer system, and as they had no Parliamentary powers to lay down underground mains, overhead lines were run in all directions. The perfection to which they brought the details of overhead construction is so fully proved by the absence of accidents that it is much to be regretted that the overhead conductors in the United States were allowed to have been put up with no regard to common sense or safety.

It is frequently stated that the Electric Lighting Act of 1882 did much towards stifling inordinate speculation, but in attempting to make people wise by this Act of Parliament, a very serious check was placed upon the development of electrical progress.

The enormous strides which have been made under the more encouraging Electric Lighting Act of 1888 will convince everyone that it was urgently required, and electrical engineers fully realize what they owe to Sir Frederick Bramwell for his share in framing this Act. One of the consequences of this Act was a deluge of applications for provisional orders. A court of inquiry was therefore ordered by the Board of Trade, who appointed Major Marindin as their inspector for this purpose.

If you carefully read the 18 days' evidence given, you will probably be convinced that every system was the best. The inquiry lasted several days, and resulted in the granting of provisional orders, confirmed by Parliament in August, 1889, to the companies mentioned in the summary on page 54, which also includes other information.

I must here gratefully acknowledge the very cordial assistance which the engineers of the various companies have given me.

We will now very briefly go round the stations of the companies, commencing with

The Kensington and Knightsbridge Electric Light Company.—This Company commenced work under the name of the Kensington Court Electric Light Company in the autumn of 1886, and under Mr. Crompton's able guidance made such rapid progress that they commenced to supply current in January, 1887, using underground mains and running their plant in a temporary building. The Board of Trade license under which the work commenced, being incorporated in the Company's provisional order of 1889, which authorizes them to supply a portion of the parish of Kensington, St. Mary Abbot, and the detached portion of the parish of St. Margaret, Westminster.

The direct current is employed in conjunction with "Howell" secondary batteries, the pressure being 200 volts on the 3-wire system, with 100 volts in the houses.

The batteries are charged at any convenient time when the engines have power to spare, and not only act as a sponge, which can be squeezed when the engine plant requires assistance, but also act as regulators, as well as maintaining the supply during the hours of minimum demand. The satisfactory use of secondary batteries in this manner has attained its present development mainly through the indefatigable labors of Mr. J. C. Howell.

Two generating stations are erected, one at Kensington court, and the other at Chapel place, Knightsbridge, the plant consisting of "Babcock and Wilcox" boilers and exhaust steam feed water heaters, "Willans'" compound

Electric Lighting Companies in London.

Name of Company.	Capital (Nominal). £	Stations.	Total Indicated Horse Power Engines.	Number of Lamps Equivalent to 32 Watt Lamps now Connected.	System.	Length of Conduit Pipe, or Single Run of Main.	Lamps per Mile.	Meters. Number.	Meters. Type.
London Electric Supply Corporation, Limited.	1,250,000	Deptford Converting Stations....	4,500	38,000	Alternate current transformers (Ferranti)	.....	.....	136 174 14	Ferranti-Mercury. Ferranti-Wright. Frager.
Metropolitan Electric Supply Company, Ltd...	500,000	Whitehall ..... Sardinia Street..... Rathbone Place..... Manchester Square.	600 3,000 1,200 2,000	44,598	Direct current and batteries.. Alternate current transformers (Westinghouse)..... Do. (Parker).....	30 miles.	1,486	25 378	Aron. Westinghouse.
House-to-House Electric Supply Company, Ltd.	350,000	West Brompton...	600	12,898	Transformers (Lowrie-Hall)..	8½ miles.	1,517	71 168	Lowrie-Hall. Westinghouse.
Westminster Electric Supply Company, Ltd...	214,765	Milbank Street..... Dacre Street*..... Eccleston Place†..... Davies Street†.....	.....	7,540	Direct current and batteries..	.....	.....	93	Aron.
Kensington and Knightsbridge Electric Supply Company, Ltd.	300,000	Kensington Court. Chapel Place	1,560, & Howell batteries	24,850	Direct current and batteries (Crompton).....	10½ miles.	2,366	200 90 34	Aron. Hookham. Aubert.
Chelsea Electric Supply Company.....	108,000	Draycott Place and 3 Distrib. Stat'ns	Batteries E.P.S.	19,500	Direct current and batteries (King) §	.....	.....	.....	.....
Notting-hill Electric Supply Company	100,000	High Street‡	.....	.....	.....	.....	.....	.....	.....
St. James and Pallmall Electric Supply Company	100,000	Duke Street.....	1,960	23,174	Direct current	4½ miles.	5,452	190	Aron.
St. Pancras Vestry.....	.....	Stanhope Street†....	.....	.....	Direct current.....	.....	.....	.....	.....
The Electricity Supply Corporation, Ltd. (formerly Messrs. Gratti)	.....	Strand.....	600	8,500	Direct current	.....	.....	.....	Frager.
			Total.....	179,060	Lamps = 8 candle power each.		Total..	1,573	

* Temporary station. † Now in progress. ‡ Nearly complete, and another station not yet commenced. § As published in the *Engineer*, 24th Oct., 1890.

engines combined direct with Crompton dynamos and "Howell" batteries in both stations. There is also a battery station situated near the center of the Kensington district at Queen's terrace-mews, where two large "Howell" batteries are placed. In all cases ample space is provided for the future extension of the plant when required. Arrangements are provided on the Kensington Court station switchboards to enable any dynamo to be used for charging the distant battery station, to which a pair of charging mains are laid. Mr. Crompton also designed for this Company a system of mains of considerable novelty, which was severely criticised at the time, but has since proved most satisfactory.

Culverts constructed with concrete or brickwork are laid under the pavements, and bare copper conductors, supported at intervals by glass insulators, are placed in these culverts. The conductors are composed of copper strips 1 in. by ¼ in., laid one over the other so as to make up the total section required. In cases where there is no room under the pavement in which to build up the culvert, wrought iron gas tubing is used, and cables insulated with thick vulcanized rubber are drawn through and connected to the bare conductors. Numerous service boxes are fixed in the pavements to enable houses to be connected without opening the ground. Four and one half miles of pipes with cables have been laid. The general route of the mains is indicated on the map on the wall.

On Dec. 1st lamps were connected to an equivalent of 24,850 32-watt lamps, and Mr. H. W. Miller, the Company's engineer, to whom I am indebted for these particulars, informs me that the lamp supply, or maximum number of lamps in use at one moment, is between 30–40 per cent. of the lamp connection.

The House-to-House Electric Light Supply Company.—This Company, as you see on the map on the wall, covers a large area, which consists of two detached districts, practically North Kensington and West Brompton. The generating station is situated off the Richmond road, West Brompton, and contains space for a very large plant.

The Lowrie Hall alternating current transformer system is adopted, with 2,000 volts on the mains. Four principal mains at present carry the current from the station, the transformers being connected to these mains where required. Cast iron pipes are laid to form a conduit, into which vulcanized india rubber "Silvertown" cables are drawn; suitable manholes, covers, and junction boxes being provided.

At present the demand for light is supplied from a plant consisting of—

Three "Babcock and Wilcox" boilers, working at 150 lbs. per square inch.

Three "Fowler" compound horizontal engines, each of 200 indicated horse power.

Three "Lowrie-Hall" alternators, each of 100 units 2,000 volts.

Three "Elwell-Parker" exciters, each of 3 units.

The engines work at a speed of 88 revolutions per minute, each engine driving 1 alternator by 7 cotton ropes, the exciter for each alternator being driven by cotton ropes from the alternator pulley.

The Lowrie-Hall pressure regulator and recording instruments are also used. Mr. Hall, the Company's manager, has kindly given me this information, and states that on their lamp connections, equivalent to 12 898 lamps of 8-candle power, the maximum lamp supply is equivalent to 5,430 lamps of 8 candle power—say 42 per cent.

St. James's and Pall Mall Electric Lighting Company.—This Company was formed for the purpose of supplying the whole of the parish of St. James', Westminster, and commenced to supply current under their provisional orders from their station in Mason's yard, Duke street, on April 4th, 1889.

The direct current is employed without batteries.

At present the above station supplies the southern half of the district, the total plant consisting of:

Five "Davy-Paxman" boilers, working at 150 lbs. per square inch.

Two large Berryman feed water heaters.

Ten Willan's compound engines, each of 200 indicated horse power.

Two Willan's compound engines, each of 80 indicated horse power.

Twelve dynamos, "Latimer Clark, Muirhead & Co.," and "Siemens," driven direct from the engines.

The whole of this plant is neatly arranged, so as to occupy the least space.

The mains consist of a network of conductors on the 3-wire system, supplied at about 100 volts at the station by suitable feeders. A cast-iron trough or culvert is laid under the surface of the pavement, and 3 conductors, each consisting of a number of strips of bare copper, which can be added to at any time, are carried by porcelain bridges, placed at suitable intervals apart. To avoid any risk of the mains touching each other, porcelain distance pieces are placed over the mains. A cast-iron lid, with water-tight joint, covers the trough. Connection to customer's houses is made by drawing well-insulated cable through gas tubing, which is screwed into the trough.

On the 5th December, a total, equivalent to 23,174 lamps of 8-candle power, were connected. Mr. Dobson, the Company's engineer, kindly informed me that the maximum lamp supply is equal to about 13,222 lamps of 8-candle power—say 57 per cent.

The Westminster Electric Supply Corporation Limited.—The district in which this corporation is authorized to supply electricity by its provisional order, comprises that portion of the united parishes of St. Margaret and St. John, Westminster, which lies to the south of the center line of the Metropolitan District Railway, and the portion of the parish of St. George, Hanover Square, covering Belgravia and Mayfair.

The system adopted is similar to that of the Kensington and Knightsbridge Company, direct current in conjunction with batteries used as regulators, and also for supply during hours of minimum demand.

Three stations are being erected, one at Millbank street, one at Eccleston place, and one in Davies street, in the positions shown on the map.

Current is now being supplied from the Millbank street station and from a small temporary station in Dacre street. The other two are being pushed forward as fast as possible, in order to supply from all stations early in the year.

Mains are being laid for 3-wire distribution, Messrs. Crompton being the contractors for the Westminster district, where the system adopted is similar to that put down by Mr. Crompton for the Kensington and Knightsbridge Company.

For other parts of the district Prof. Kennedy, the engineer to the Company, has devised the arrangement shown in the plan on the wall; bare copper strip rests on stoneware insulators placed from 6 to 8 feet apart, and bedded in the concrete culvert as shown. The copper is stretched by a special tool before being pulled in, and this process gives it sufficient stiffness not to sag perceptibly between the insulators. The total sectional area of the conductors can be increased when required by the addition of more copper strip. Feeders are used in a most systematic manner, and Prof. Kennedy is to be congratulated on the favorable prospects of this Company's work. There is a large demand for light in the district, and the rapid progress of this Company justifies the expectation of a speedy supply from the stations now in progress.

The London Electric Supply Corporation, Limited.—The Parliamentary powers possessed by this Company cover a large area, comprising the district bordering the south side of the Thames from Westminster bridge to Greenwich, Mayfair, Belgravia, St. James and Pall Mall, St. Martin's-in-the Fields, part of Westminster, Chelsea, and two isolated areas, namely, Newington and Clerkenwell.

The Ferranti system is employed throughout, alternating current being generated at an extra high pressure and transmitted to converting stations, from which it is distributed at high pressure to the service converters.

The corporation has erected a large station at Deptford, which has been admirably designed for the purpose, having road-frontage, wharfage and coaling dock. The plant consists of 24 "Babcock & Wilcox" boilers, four compound vertical engines by Hick & Hargreaves, two of which are 1,500 indicated horse power each, and two of 750 indicated horse power each. There is almost unlimited room for future extension.

Each of these engines drives a Ferranti dynamo by cotton ropes, the exciters being driven direct from independent engines.

In order to convey the high pressure from Deptford to London, Mr. Ferranti devised a special form of main for this purpose, which has been frequently described.

About 28 miles of these mains have been laid, the distributing mains from the converting stations being of various kinds. This Company's Grosvenor Gallery station having lately been closed, a hurried change has had to be made in order to enable the corporation to supply from Deptford.

[To be continued.]

Coal Versus Gas in Pittsburgh.

The following interesting details respecting recent data on the above named subject is from the Pittsburgh *Despatch*:

According to recent reports, there are 14 mills here (not including McKeesport) that have changed back to coal in the puddling furnaces, although in two of these some of the furnaces are yet working on gas. In these mills there are 454 puddling furnaces, while the total number of furnaces in Allegheny county, including McKeesport, is 1,152. At the National Tube Works Company, McKeesport, every department of the four rolling mills is again using coal. About 15,000 bushels are

being consumed daily. The company intend erecting a coal elevator on the river bank near their works, in order to transport the coal from the barges to the mills. They recently erected at their No. 4 mill 15 double puddling furnaces, and these will now have to be torn down, owing to their not being adapted to the use of coal; either natural or artificial gas must be used in these furnaces.

At the Clinton Mill, on the South Side, five double puddling furnaces are standing idle, while the single furnaces are using coal. At the Republic Iron Works, on Twenty-fifth street, South Side, they are still in a condition of gas shortage. The new puddle forge, consisting of 14 double puddling furnaces, will have to be torn down. The old forge, comprising 26 single furnaces, is back to coal, and a part of the finishing department is likewise back to coal. It is thought that the recent gas strike by Jones & Laughlin, whose mill adjoins there, will urge the Republic to try for gas. At Howe, Brown & Co.'s mill on Sixteenth street, coal is being partially used. In the Millvale mill the puddling department is equivalent to 36 single furnaces, but only 21 of these are built single. At this mill there are two quadruple furnaces, being about the only furnaces of their kind about Pittsburgh. In one turn the total output of one of these furnaces is about 12,000 pounds, while of a single furnace it is 2,500 pounds.

The Pittsburgh Forge and Iron Company are using coal in all their puddling and scrap furnaces, and artifical gas in their heating department. About 7,000 bushels of coal will be required daily at this mill. At the Lockhart Iron and Steel Works, Chartiers, the puddling furnaces have been changed back to coal, as has also the puddling department in the Soho mill of Morehead, McCleane & Co., Lindsay & McCutcheon and Chess, Cook & Co. are now using coal entirely. The consumption in these mills is almost 10,000 bushels per day. At Painter's mill, in the West End, 16 puddling furnaces in the new forge were on last week, and 44 off owing to the shortage of gas; in the old forge 24 furnaces are idle and under repairs to resume coal during the week. The firm is experimenting with the Archer process of fuel gas. It is understood that the LaBelle Steel Works of Smith Bros. & Co., in Allegheny, also the United States Iron and Tin Plate Company, Linden Duquesne Tube Company and the Pittsburgh Tube Company are experimenting on this process.

At the American Iron Works of Jones & Laughlin the puddle furnaces that were changed back to coal when the gas gave out are now being returned to gas, the company having struck two wells of their own that furnish them more than an ample supply of gas. The works are now running full in all departments, with the likelihood of continuing so throughout the winter. The old wells have been plugged and reserved for possible future use. In the Upper Union Mill of Carnegie, Phipps & Co., Thirty-third street, there is still considerable trouble on account of the gas shortage. During the last month the puddling department has been making only 2 or 3 heats per turn, but the finishing department is working full, turning out about 275 tons of finished iron and steel per turn. At Oliver Bros. & Phillips, lack of gas has made it necessary to fall back on coal in the puddling department. Of 42 furnaces, 28 have been changed, as far as we can learn, and these are using the slack and cold blast process, which was the general fuel mostly used by this Company previous to the adoption of gas. It is likely that superheated steam and slack will be generally used in the mill.

This is the same process as is used in the entire puddling department of the Vesuvius Mill of Moorehead Bros. & Co. and the Kensington Mill of Lloyd, Son & Co. This process is the newest substitute for fuel in puddling furnaces, and it is claimed its cost is only one-half that of gas. It is charged with slack coal, and the combustion is forced by the introduction beneath the grate bars of superheated steam. A water gas is produced by the decomposition of the steam. Park Bros. & Co., are building an 8 and 10-inch natural gas main from the Wildwood field to their Black Diamond Steel Works, on Thirtieth street, costing $80,000, in order to insure a sufficient supply for their works. It is thought that by the first of the year all the mills now undergoing a change to coal will be in a position to run steady. Operations during last month were greatly interrupted by the withdrawal of gas from the puddling furnaces, and the production of muck iron during the month was not over 36,000 tons.

[Contributed to the London *Builder*.]

Cement Tests.

By Mr. T. H. Beare.

The tests, the results of which are given in this article, were made by the author in his engineering laboratory, University College, London. They were made chiefly with the object of ascertaining if the method of gauging the briquettes by dry pressure, and then allowing them to suck up water for a given time, gave more reliable and trustworthy results than ordinary hand gauging, and also to determine the rate of gain of strength of such briquettes with age.

This method, devised by Mr. Arnold, is as follows: The moulds are of the ordinary form and cross section; but for briquettes, which, when finished, are to be 1 inch thick, they are 2 inches deep; the moulds are placed on a stout, flat tray, with a shallow rim all round it, and are filled with dry cement, a weighed quantity (0.3 lb.) being placed in each; a brass die, the exact shape and size of a finished briquette is then placed on the top of the cement in each mould, compressing the contents; this compression is completed under a small hand screw press, and the dry cement is so compacted that it occupies only half of the mould; the die is then flush with the top. We have thus a briquette of exceedingly closely compacted dry cement exactly 1 inch thick; water is then poured into the tray, and the cement absorbs this by capillary attraction—this goes on for 20 minutes; the briquettes are then removed from the tray and placed on a table, die down, to set for 24 hours. The after-procedure is precisely the same as in the ordinary methods; the briquettes are taken out of the moulds at the end of the above 24 hours, and at once placed in water, where they are left for the intended time, then taken out and immediately tested.

Since in this method it is rather difficult, owing, perhaps, to a slight recovery of the die on releasing from the press, to insure that the briquettes are exactly 1 square inch in section, they were all measured; the areas, however, varied but little from the inch, the smallest being 0.96, and the biggest 1.04 square inches. In all cases, however, the total breaking load was corrected for the real area.

The machine used in the tests was made by Kuhlman; it is the standard German form, an ordinary double lever one with a leverage of 50 to 1. It is an excellent little machine for use. There was no automatic arrangement, the shot being poured by hand. Extreme care was taken to keep the flow constant. The rate was about 400 pounds a minute on the test piece, so that the weaker specimens were broken in about a minute, the stronger in one minute and a half. For these the initial loads were 5 pounds—*i. e.*, 250 pounds, on square inch, against only 1 pound, or 50 pounds per square inch, for the weaker ones.

The briquettes were all in fracture exceedingly compact and close grained. This is a result of the fact that while an ordinary hand-gauged one of this size contains about 0.26 of a pound of cement, these had 0.3 of a pound, or about 15 per cent. more; the compactness must, therefore, have been much greater than in the ordinary method. They were all made from one barrel of cement (supplied to the author by the London Portland Cement Company) kept carefully dry when not in use. The experiments lasted over a period of three months; it is quite certain however, that the cement was just as good at the end as at the start. It was originally intended to have three briquettes in each set, but it was afterwards decided to have five. The first set was tested immediately after removal from the mould, the second after one day in water, the third after two days, the fourth after three days, the fifth after four days, and then each succeeding set was four days longer in the water than the one before. In a few instances, where a briquette was a good deal weaker or stronger than the average of the set, a fresh series of five were made; in the table, however, all the results are given; it was only necessary to discard two out of the 114 made, in both cases because some impurity had got mixed up in the dry cement in gauging them. The table gives the mean of each set, and the range of strength above and below the mean, the notes appended to it explaining any peculiarities. A diagram showing the results graphically is also given; from this it is quite clear that the rate of increase beyond 52 days would be small. A curve approximating closely to the actual results is also shown.

In conclusion, the author would like to draw attention to the necessity of engineers and architects adopting some standard tests for cement, as is done in Germany. It is a much more difficult matter to secure satisfactory tests of cement than of such materials as iron and steel; there are so many things likely to affect the results. There is always a certain amount of uncertainty in briquettes gauged by hand, the personal equation of the operator becomes so important; if, therefore, some such apparatus as the one used in the above were adopted, one element of uncertainty would be eliminated. It is not denied that a clever manipulator might, over a series of experiments like this, obtain results quite as uniform, but the chances are against it. Then, too, a standard rate of test should be adopted, and also the number of briquettes needed for a test. At the same time, the other tests, such as fineness and weight, might also be standardized. It seems hopeless to expect a general agreement about ordinary iron and steel tests, but surely it would be an easy matter to come to an agreement in the case of cement.

It is certain that this form of gauging gives higher results with neat cement than hand gauging, so that a new minimum strength would need to be fixed. This could easily be done by a series of comparative tests with the same qualities of cements, gauged by hand and by pressure. This question of standard tests has been frequently urged by Mr. Grant, Mr. Faija and many others.

Table Showing Strengths and Ages of Cement Briquettes.

Number of Briquettes in Set	Number of Days Setting in Water.	Breaking Load in Lbs. per Square Inch.	Departure from Mean Values in Set.	
			Over Mean. Per Ct.	Under Mean. Per Ct.
5	0	267	18.3	18.3
5	1	281	18.5	14.6
5	2	342	19.0	19.6
5	3	384	7.3	6.3
10	4	422	16.1	6.6*
20	8	484	14.6	16.4†
5	12	519	5.8	4.1
15	16	549	22.0	24.0‡
5	20	624	7.0	7.4
5	24	645	6.0	4.0
5	28	650	5.7	13.7§
5	32	694	10.1	7.1
5	36	725	5.5	4.0
4‖	40	723	10.2	6.4
4‖	44	742	5.3	6.3
5	48	684¶	5.1	6.6
4**	52	773	9.5	7.0

* Mean of first set, 438 ; of second set, 405 lbs. ; second set extremely regular ; first varied 11.9 per cent. above, and 10 per cent. below mean.

† Mean of first set, 480 ; of second, 450 ; of third, 496 ; of fourth, 511; the variations were respectively, 17.1 per cent. above ; 15.6 per cent. below ; 26.0 per cent. above ; 13.1 per cent. below ; 9.9 per cent. above ; 12.1 per cent. below ; 7.0 per cent. above ; 3.7 per cent. below. The strongest was thus much the most uniform, while the weakest set had the strongest (567 lbs.) and the weakest (391 lbs.) briquettes.

‡ Mean of first set, 552 ; of second, 536 ; of third, 560 lbs. Variations: 11.2 per cent. above ; 24.4 per cent. below ; 13.4 per cent. above ; 10.4 per cent. below ; 19.8 per cent. above ; 17.1 per cent. below. The sets were thus all irregular ; but eliminating the very strong one of set 1, and the very weak one of set 2, the grand mean is 551—very close indeed to 549.

§ Eliminating a very weak one, the other four being very regular, this mean would be 671 lbs.

‖ One in each set rejected because of flaws.

¶ No explanation can be given of this anomaly ; two were gauged at one time, three at a later time ; the tests were, therefore, on different days ; the results are all fairly uniform one with another, and were carefully checked.

** Only four were made in this set.

Observations of a Constructing Electrical Engineer.

Mr. C. E. Woods, who has devoted much attention to electrical engineering in a practical way in this country, is to be congratulated on the frankness with which he puts things, in respect to that which he has observed in the carrying on of his business. Writing to a contemporary on the matters outlined in the heading, Mr. Woods says :

In reading the different papers devoted to the electrical interests one cannot help noticing that most of the matter published in them bears upon the theoretical side of the question, and that very little space seems to be given to the plain, common everyday side of it. Now while theorising is necessary, it should be remembered that in addition to theoretical problems we have some very pratical ones to solve, and I will try to present some of them in this article, taken from the standpoint of a constructing electrican, which is my humble vocation, and I think my brother engineers will say I am right. While I lay no claim to being an electrical expert, I have had considerable experience in construction work, and I am sorry to say my work comes a long way from being satisfactory to myself for reasons that I will present later on. First, what is a constructing electrician or electrical engineer ? He is the medium through which electricity in its various forms is introduced to an ignorant public. He is the one who must put into satisfactory operation the electric plants for light and power purposes. He is the one who must carry out the plans of half a dozen different men to obtain the desired result. He must learn when to take care of and operate his system, whatever it may be. He must be ready for any and all emergencies, and is supposed to be infallible, but in this respect it sometimes proves to be a case of misplaced confidence. But, poor fellow, he has much to contend with, and much trouble that is not of his own making, and the greatest of all is the everlasting desire of the American public for cheapness. This is a practical problem that some of the great and learned minds ought to endeavor to solve. It may be asked, what do you mean by cheapness ? I mean the cheap material, cheap workmanship and cheap labor that electrical engineers are obliged to use. We have as good material in our market as could be desired, but people won't pay for it, at least as long as they can help it. I saw an article not long since in one of our leading papers telling how much better the material and work were in England than in America. Now, America has just as good material as can be procured, but American people won't pay for it, and as long as they are allowed to use cheap material, and just as long as the consumer can say what he shall pay and what kind of material shall be used in his particular installation will the electrical engineer be obliged to do poor work and use poor material. To be sure the insurance companies have taken it up to a certain extent, but of a truth it doesn't go very far. And to sum it up, in short, inside wiring in this country is, generally speaking, more a matter of dollars and cents than good work and material. I would suggest that if people will not do any different of their own accord, some means ought to be devised by which they will be forced to. If the insurance companies cannot enforce it let some one introduce a bill carrying with it a set of rules and regulations for this purpose into the legislature and see if something cannot be accomplished in that way.

Now when it comes to line work it is something dreadful to think about. There are absolutely no rules relative to this branch of the work that can be enforced, except in some few local instances ; and of all the cheap unsightly work that ever was done the average construction of to-day is, I believe, the worst. It comes of course from close competition between the various systems in some instances, but not always, for often local companies put up their own line work under the supervision of a man who knows little or nothing about it, hoping thereby to save something. But by so doing they make a grand mistake, which they sooner or later find out to their sorrow. This state of things will exist as long as local companies and manufacturers of different systems can pursue their individual methods in the matter.

Electrical engineers would gladly do better work if their respective companies could get a price that would allow them to, and so this, like inside wiring, narrows itself down to a matter of dollars and cents. At present there seems to be no help for it, for no company can or will give a dollar for 50 cents ; but if all companies were forced to bid on work and material of some standard quality it would then be a case of the survival of the fittest. The trouble is we have too wide a range of material, both as to quantity and quality, that we are allowed to use. This is the whole matter in a nutshell.

And now we come to the most vital and interesting point of all, namely, the care and management of electrical plants ; and while some of the older and abler minds are working out some of the theoretical problems let us look at one or two practical ones. First we have to contend with the same mania for cheapness in both consturction and labor. Of course we understand there are some splendidly equipped plants, and under the management of thorough electricians, but it is only in the larger cities. In most of the smaller towns the electrician, so called, is usually a fellow who has learned all he knows from the electrical engineer while the plant was in process of construction for a period of 3 or 4 months. As long as he has no accidents and the plant does not need to be increased everything goes well. But after a little they commence to add to their work and then the trouble begins to brew. Those entrusted with the management commence to experiment and as a result they soon turn the plant into a failure, both electrically and commercially. Again, a plant is seldom found equipped with any portable instruments better than a $5 magneto, outside of those that belong to the system proper. Why ? Because they cost money, and if the company had them there is no one connected with the plant that would know how to use them, and as long as individual companies can control these things so long must we put up with useless accidents, poor insulation, companies that don't make money and a general inefficiency all around. I sincerely hope that some of the electricians who are in a position to better this condition of things will ere long look this ground carefully over and see if something cannot be done. It is certainly good food for thought. One thing is certain : until some step is taken in this direction manufacturers of electrical apparatus need not expect to give the satisfaction they desire to, and central stations will not earn as much as they ought to earn.

We are sorry to hear that the Saratoga (N. Y.) Gas and Electric Light Company is experimenting with the process of gas making, the patents, etc., for which are controlled by the Acme Liquid Fuel Gas Company.

Ramsdell's Apparatus for the Manufacture of Wood and Oil Gas.

On December 9, 1890, U. S. Letters Patent (No. 442,493) were granted to George Ramsdell, of this city, for improvements in apparatus for the manufacture of wood gas enriched with oil gas. In the specification the inventor says, substantially :

The particular object of the invention may be cited as providing a bottom for the oil retorts of a non-combustible and non-porous material to effectually prevent the retort, which is ordinarily constructed of clay, from absorbing the oil, thereby causing rapid decay and leakage of the retort, the said auxiliary bottom also materially assisting in an economic and rapid vaporization of the oil.

Another important feature of the invention is to so construct the oil-

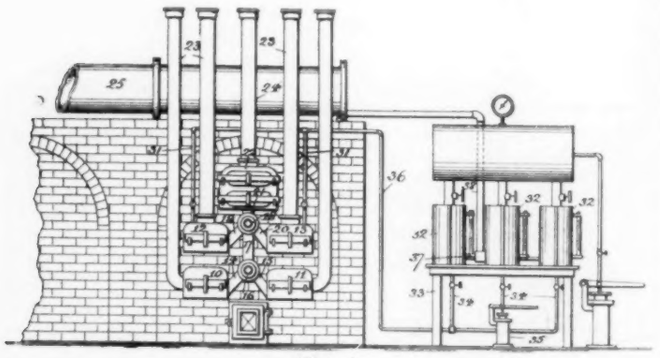

Fig. 1.

feed pipes leading into the retorts that the said pipes will not become choked by the deposition of carbon, and wherein the oil vapors are released before the hottest portion of the retorts is reached, and that portion of the oil not vaporized conducted to the hottest surface, or to the rear of the retorts.

Certain features of construction employed in my complete apparatus and covered by patents previously granted to me (one of which is numbered 247,516, and dated September 27, 1881) are shown herein, in order to represent the inventions in the manner in which I shall use them. These improvements heretofore mentioned in preceding patents relate, first, to the method of generating the wood gas and treating the same before mixing it with the oil vapor ; second, to the manner of controlling the introduction of the wood gas and oil vapor into the mixing chamber prior to their joint passage into the superheater, and third, to the manner of feeding the oil retorts by atmospheric pressure ; and in said patents, in order to change the carbonic acid in the wood retorts into carbonic oxide, and thereby increase the illuminating properties of the gas, the latter is passed through a bed of charcoal located in the lower portion of the appropriate retort. The gas is made to pass through the mouthpiece of each retort by pipes leading from the compartments of the retorts, the respective pipes of the different retorts being connected with valved devices adapted to permit communication with any one or more closed retort.

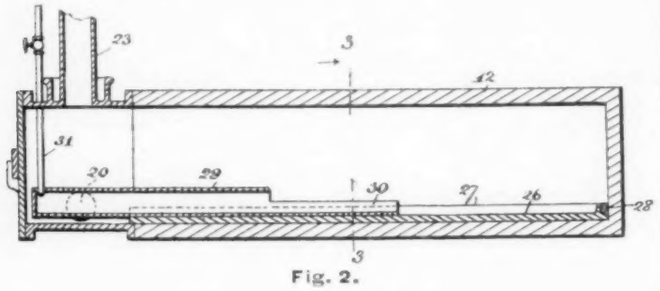

Fig. 2.

The invention consists in the novel construction and combination of the several parts, as will be hereinafter fully set forth and pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar figures of reference indicate corresponding parts in all the views.

Fig. 1 is a front elevation of a bench of retorts provided with the several improvements. Fig. 2 is a longitudinal vertical section through the oil retort and also through the oil and vapor feed pipe located in the same. Fig. 3 is a transverse section on line 3 3 of Fig. 2, and Fig. 4 is a perspective view of the auxiliary bottom of the oil retort detached therefrom.

Two wood retorts, 10 and 11, are located in the same horizontal line, one of them below each oil retort, 12 and 13. A pipe extends from the inner side of the mouthpiece of each wood retort, 10 and 11, in an inclined upper direction, as illustrated in Fig. 1. The said wood retorts have their pipes, 14 and 15, connected with a valved chamber 16, the latter being provided with a rotary valve adapted to close one or both of these pipes from communication with its chamber. This valve may also close the communication of its chamber with the vertical pipe 17, leading from its top to the bottom of the mixing chamber 18. The pipe 19, which leads from the left hand oil retort 12, connects with the mixing chamber on one side of its lower portion, and the pipe 20, which leads from the right hand retort 13, connects with the said mixing chamber on the other side of its lower portion. The inclination of the pipes 19 and 20 corresponds with the inclination of the lower pipes 14 and 15.

A vertical pipe 21 leads from the top of the mixing chamber 18 to the bottom of the mouthpiece of the superheating retort 22. The mixing chamber 18 is fitted with a valve adapted to close any one, two, or all of the pipes which lead into the mixing chamber, or to close the pipe which leads therefrom to the superheating retort. The several pipes which lead from their respective retorts are arranged at the sharp angle

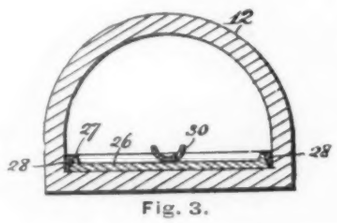

Fig. 3.

or inclination indicated, in order to prevent the deposition of carbonaceous matter therein.

The valve devices are adapted to permit any one or a number of the different generating retorts to be shut off from the others, so that any retort may be individually charged or otherwise attended to independently of the other retorts. In the event that the superheating retort requires attention it may be closed off from the mixing chamber, the oil vapor and the wood gas being passed through their respective stand-pipes 23. The latter and the central stand-pipe 24 of the superheating retort are provided with dip-pipes formed at acute angles therewith and extending rearwardly downward, so that all tendency to the deposit of carbon in the dip-pipes may be avoided.

The dip-pipes are connected directly with the hydraulic main 25, the dip-pipes of the stand pipes 23 being made to extend within the hydraulic main a greater distance than the dip-pipes of the central stand-pipe 24. The heavier sealing of the dip-pipes of the retort stand-pipes prevents the wood gas and the oil vapors from being passed through them into the hydraulic main, while the valve apparatus heretofore referred to does not positively cut any of them off and is in normal operation ; but when from any cause the gas or vapor cannot pass in regular order through the superheating retort it can find exit from the retort by passing through the heavy sealed dip-pipes directly into the hydraulic main.

The oil retorts 12 and 13 are each provided with an auxiliary bottom 26, which bottom is preferably of a width at its under surface corresponding to the width of the main bottom of the retort, and at each side and the inner end the auxiliary bottom is provided with an upwardly-

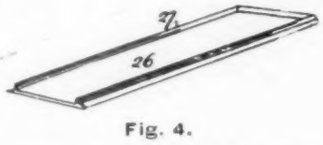

Fig. 4.

extending flange 27, located near the edges, as best shown in Fig. 4, and the space intervening the side walls of the retort and the contiguous sides of the flanges 27 is ordinarily filled in with a packing, 28, of fire-clay or its equivalent, as in Fig. 3. The auxiliary bottom 26 is preferably made of metal ; but any other non-porous material capable of withstanding high degrees of heat may be substituted, if in practice it is found desirable.

Retorts are ordinarily constructed of clay, and when the retorts are adapted for the vaporization of oil, the oil is to a great extent absorbed

by the bottom of the retort with which it comes in contact, and the retort at that point shortly becomes so saturated as to leak and be rendered unfit for use. The object of providing the auxiliary bottom is to protect the main bottom of the retort and not permit the oil to come in contact therewith, thus providing also for a more rapid vaporization of the oil and decided economy in the use of the latter.

In each oil retort a feed pipe 29 is located, preferably longitudinally of its central portion, the said pipe being closed at its outer end and of a sufficient length to extend from a point at or near the mouth of the retort to a point preferably at the rear of its center, and the rear portion of the feed pipe 29 is cut away at the top, so that the interior of the said pipe at this point is exposed, and the said pipe is semicircular in cross-section, as illustrated at 30, in Figs. 2 and 3. Oil is supplied to the feed pipes 29 of the oil retorts at or near the forward end of said pipes by vertical, valved tubes 31, receiving their supply from a fount in a manner to be hereinafter described.

At this point it may be well to state that by providing the supply pipe, substantially as described, for each oil retort, the vapors generated find a speedy exit from the pipe before said vapors are carried over the hottest portion of the retort, and by permitting this speedy escape of the vapors the supply pipes do not become clogged by the deposition of carbonaceous matter therein, and the uncovered rear portions of the supply pipe sections conduct the unvaporized oil directly to the hottest portion of the retort, thereby assuring its rapid and successful vaporization.

It will be observed that by reason of the two important improvements herein mentioned—namely, the auxiliary bottom of the retort and its peculiar oil supply pipe—not only is there a decided economy in the use of oil obtained, but the vaporization of the oil is materially expedited.

To supply the oil retorts with their charge, a series of oil tanks, 32, are provided, seated upon a properly constructed stand, 33, Fig. 1. Each oil tank has a pipe, 34, leading into its bottom from an oil pump, 35, and the supply pipes, 31, are connected by a line of pipe, 36, with the said pipes, 34, of the oil tanks. The pipes, 34, are provided with suitable valves, so as to retain in the tanks the oil forced therein. From the lower side portion of each tank there is led a pipe, 37, and the several pipes, 37, are connected with a single standpipe, 38, which pipe is carried over the bench and down into one of the oil retorts near the rear portion of the same. When two oil retorts are employed, two standpipes, 38, are used. The standpipe, 38, is a delivery pipe, and may be termed an "alternative device," as it is not employed to supply oil to the retorts when the supply pipes, 31, are in proper working order; but should anything happen to the latter pipes the stand or supply pipes, 38, may be brought into requisition.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

FRANCIS B. JROCKER and Dr. Michael Pupin are under engagement to deliver a course of evening lectures, at Columbia College, on "Practical Electricity," the lectures to be given on successive Thursday evenings, commencing the 15th inst. The lectures will be profusely illustrated by experiments, and will practically cover the subject, comprehensive and far-reaching as the latter is. The fee for the course has been put at $10, payable in advance, at the time of registration.

THE Kingman (Kas.) Water and Light Company has been incorporated by Messrs. Frank Vincent, John F. Vincent, John W. Hood, Robert G. Brodie and Vernon C. Jarboe. It is capitalized in $100,000. This place is the capital of Kingman county, Kas., on the Chikaskia river, at a point 32 miles south of Hutchinson.

A WARSAW (N. Y.) correspondent, writing under date of December 26th, says: "I read in a recent issue of the JOURNAL your mention of the fact that the Trustees of Warsaw have entered into a contract with the Warsaw Electric Light and Power Company for the public lighting by means of arc lamps. As your notice of the same was very brief, I thought an additional line or two in explanation might not be without interest. The contract binds the Company to maintain 25 arc lamps (2,000-candle power each) for a period of 5 years from May 1st, 1891, the arcs to remain lighted, on 22 nights of each month, from sunset to midnight, the rate of pay for the service to be $65 per year per lamp. The Company further agrees 'to indemnify and save the village harmless from any negligence on its part in the matter of the construction or operation of the system of electric lights.'"

THE Fort Wayne Jenney Electric Light Company's station at West Indianapolis, Ind., was recently put in the hands of the sheriff on account of the continued refusal of the Company to pay its city and county taxes. The sum in dispute was $500.

IF certain negotiations can be successfully brought off the shops of the Goodwin Gas Stove and Meter Company will be removed from Philadelphia to Bordentown, N. J.

THE annual meeting of the Peoples Gas Light Company, of Cleveland, O., will be held on Wednesday week.

COMMISSIONER ADAMS, of Brooklyn, N. Y., has received the following bids for the public lighting of that city for the ensuing year:

Company.	Price per Lamp per Annum.
Metropolitan Gas Light Company	$21.25
Williamsburgh " "	21.00
Brooklyn " "	19.80
Nassau " "	21.25
Peoples " "	21.25
Citizens " "	21.25
Municipal Electric Light Company	182.50
Citizens " "	182.50

The amount of the appropriation is $500,000. The gas lamps carry burners rated to 3 feet, and the usual mythical high power is called for in the arc lamp specifications. Both classes of lamps are to be kept in service for 4,000 hours per annum: the Companies to light and extinguish.

THE public lighting specifications for the District of Columbia provide that not more than $21.50 for each gas lamp shall be paid for a lighting service covering a period of not less than 3,000 hours each year. It is also decreed that not more than 55 cents per night shall be paid for each 2,000-candle power arc light, the burning time for arcs to be from sunset to sunrise of each 24 hours in the year.

THE amended articles of the Lincoln (Neb.) Gas Company have been filed. Under the new agreement the capital stock is put at $500,000.

THE New Albany (Ind.) Gas Light Company has arranged for a considerable addition to its electric lighting plant.

About three years ago the City Council, of Pine Bluff, Ark., under an agreement with the proprietors of the Pine Bluff Water and Light Company, promised to pay the latter the sum of $1,200 monthly for a service to the city of a certain number of public gas lamps and arc lights and a certain supply of water to a stated number of hydrants. For the past two years the city has met these obligations by paying the Company in warrants on the city treasurer. The Company did not cash the same—city warrants are at a considerable discount—preferring to hold them in the knowledge that in time the warrants would be worth almost their face value to those who would secure them for paying taxes, licenses, etc., to the city. A very smart lawyer named M. A. Austin, who probably for the lack of other business, recently conceived the idea that a search in the records of the City Clerk's office might unearth something to his advantage, and he now comes forward with the first fish that his drag net among the archives has enmeshed. He finds that the contract between the city and the Company was never recorded, and hence claims that the service rendered by the Company did not create a legal debt. The counsellor, meanwhile, admits that there is no doubt that such a contract was originally entered into. There's an honorable disciple of Coke! The upshot of the Austin discovery and logic is likely to be that the Company will hereafter accept nothing but cash from the city and will insist on its immediate redemption at par of the i. o. u. bills now held for service performed.

MEETINGS of the stockholders of the Kingston (N. Y.) Electric Light, Heat, and Power Company and the Rondout and Kingston Gas Light Company will be held on the 15th inst. for the purpose of approving an agreement between the two interests for their consolidation. It is proposed to form a new corporation, to be known as the Kingston Light, Heat and Power Company, with a capital of $247,500. The Board of Trustees to manage the new corporation for the first year will be Henry D. Fuller, Robert B. Taber, Herbert A. Smith, Wm. F. Dean and Frank P. Slade. This looks as if the Thomson-Houston Company had at last managed to secure control of a property in Kingston and Rondout that will bring it in some profit—something that their electric lighting ventures in that locality never did.

SOME months ago we reported the standing in the first trial court of an interesting case that was brought against the Utica (N. Y.) Equitable Gas and Electric Light Company, by Embley Brothers, shopkeepers in that city. The first trial resulted in a verdict for the plaintiff, and on an appeal to the County Court that tribunal decided also in favor of the

plaintiff. The following resume of the case, for the details of which we are indebted to a correspondent at Albany, N. Y., will be found worth reading: "The case of Geo. A. Embley and Walter S. Embley, composing the firm of Embley Brothers, shopkeepers at 159 Genessee street, Utica, against the local Gas Company, was recently decided in the local County Court, brought there on appeal by the Gas Company. Messrs. Matteson and Harvey appeared for plaintiffs and N. E. Kernan for the defendant. The history of the case is: Early in 1889 Embley Brothers used electric lights and gas in their store, both lighting mediums being supplied them at that time by the Equitable Gas and Electric Light Company. During the spring of 1889 they made a contract with the Utica Electric Light Company to supply them with electric light alleging their intention, however, to use this light in connection with the gas of the Equitable Company. On June 30 the latter removed its meter from their premises, it being understood at the time that the Equitable Company would not furnish gas to the firm if they insisted on receiving a supply of electricity from the Electric Light Company. On August 1st the Embleys made application to have a gas meter put into their store, but the Gas Company refused to do so. On November 4, 1889, action was brought by the Embleys against the Gas Company to recover damages. The suit was tried before Judge Gaffney, who decided it in favor of the plaintiffs in an opinion which was published at the time. Judgment was awarded for $170 and costs. Walter S Embley was the only witness for the plaintiffs, while Harold Graham, Manager of the Equitable Company, and Horace B. Shulters and John Hovey, two of the employees, were examined on the part of the defense to show that for a month previous to the removal of the gas meter no gas had been used. After Mr. Embley's examination, Mr. Kernan moved for a nonsuit, and when defense had presented its case he renewed the motion, on the ground that the plaintiffs were not using gas; that the application for a meter was not made in good faith, and that gas was not required to light the premises. The statute (section VI., chapter 311, laws of 1859) provides that a gas company shall, on proper application by the owner or occupant of a building, supply gas as may be required for lighting the premises, and that for refusing to grant such a request the company shall forfeit $5 per day for every day after the making of the application until the meter has been put in. The plaintiffs only put in a claim for damages from the time of the application until the commencement of the action for damages. Mr. Kernan interposed the further plea that no gas was required to properly light the premises, because of the electric light; but the Court held against him. Mr. Matteson moved that the judgment of the lower Court be affirmed, and asked the Court to render a verdict for $170 and costs. Mr. Kernan said he wanted the case to go to the jury on various questions of fact, but the Judge—Hon. Mr. Evans—granted the Matteson motion."

In our last issue we noted that a fire occurred at the works of the Grand Forks (N. Dak.) Gas and Electric Company, but that no considerable damage was occasioned thereby. Since that item was published we have received the following particulars of the fire, which were kindly furnished by the Company's clever Superintendent, Mr. Thomas Roycraft: "On the morning of December 16th we had a slight fire in our electric generating room, and as our power is derived from gas engines the origin of the fire is not quite clear to us. However, the flames were speedily extinguished and the loss will not exceed $600, principally on belting and building. The machinery was not injured to any great degree, save that the dynamos were pretty thoroughly water soaked. By noon of the same day I had the dynamos running idle—that is, without generating any current—for the purpose of drying them out; and on the night of the 17th we were running as usual. So, you see, we did not lose much time."

The Cincinnati (Ohio) Gas Company has declared its usual quarterly dividend of 2½ per cent. The books were re-opened on the first inst.

A Philadelphia authority says "that but once in 1888 prior to the month of December did the city's gas consumption in a day reach 14,000,000 cubic feet. During the last month, however, that figure was reached on the following days: December 1, 14,008,000 feet; 8th, 14,588,000; 12th, 14,168,000; 15th, 14,188,000; 16th, 14,231,000; 17th, 16,103,000; 18th, 14,012,000; 19th, 14,337,000, 22d, 14,200,000; 23d, 14,328,000; 24th, 15,379,000." An imposing array of figures, which also prove that Philadelphia is not such a very "sleepy place" after all.

The death of Mr. Corydon Wheat, of Geneva, N. Y., is reported as having taken place at his home in that city on the evening of the 24th December. He was born in Orleans, N. Y., 1829, but had been a resident of Geneva for 53 years. He was a Director in the Geneva Gas Light Company, and was very prominent in mercantile affairs in that section of New York.

The Kearney (N. J.) Town Committee has entered into a contract with the East Newark Gas Company, under which the latter is to maintain 35 public gas lamps, to burn each night and all night, at the rate of $23 per lamp per annum. The contract is to last for one year.

The Brattleboro (Vt.) Gas Light Company has notified its consumers that those who use not less than 20,000 cubic feet of gas per month are to be entitled to an additional rebate of 25 cents per 1,000.

The Hartford City (Conn.) Gas Light Company has declared a semi-annual dividend of 4 per cent. Manager Harbison said some time ago that that cut in dividend rates would be only a temporary one.

William Harkness, of this city, has filed a bill of complaint against the United Gas Improvement Company, in which he alleges that the latter is infringing on patents owned by him.

The Alton (Ills.) Gas and Electric Light Company's plant is to be enlarged and improved again, President Underwood evidently having determined that an expenditure of time and money in improving the property will be more than returned in the future in increased receipts and greater satisfaction to the Company's customers. In any event, Superintendent Tracy has been authorized to put down a 6-inch gas main from the works through the main business street of the city, and will also carry the line down Second street as far as Alton street, to supply the new opera house. It has also been determined to sell the old electric light plant and to install a new outfit, the new station to have a power equal to 100-horse. This will enable the Company to distribute electric currents for lighting and power purposes in Upper Alton. The improvements will necessitate the building of a large new power house, and it is estimated that not less than $25,000 will have to be expended before the work can be said to be over.

The offices of the Metropolitan Gas Light Company, of Elizabeth, N. J., are to be located on Broad street, near East Grand street.

The new iron roof for the extension of the rolling mill in the works of the Lackawanna Iron and Coal Company, at Scranton, Pa., will be built by the Berlin Iron Bridge Company. The same contractors are also putting up the new casting shop for the Midvale Steel Company, of Nicetown, Pa.

The Board of Alderman of Boston, Mass., some weeks ago entertained an order which called upon the Mayor to petition the legislature for the passage of an act compelling the Gas Companies of Boston to furnish gas of a standard quality to their consumers. Which order, of course, was eminently proper, always provided that the companies were not complying strictly with the Bay State Statute which prescribes the quality of gas that shall be sent out by all the Gas Companies of Massachusetts. In the meantime, it would seem the proper thing to say that the officials charged with determining the quality of Massachusetts gas have gone on with their duties in most methodical style and in a spirit of fairness to the companies and of justice to the consumers. Further, Inspector Hinman, judging from his past record of faithful service to the State in the capacity of its official Gas Inspector, scarcely earned the slur implied in the aldermanic order that gas distributed in Boston was not up to standard. As we understand it, however, the Board was hoisted with its own petard, in that the Mayor, having received the order and petition, and having in accordance with the prompting of common sense, applied to the proper source for obtaining the knowledge whether or not the gas was of the quality prescribed by law, only to discover that it was well in excess of the standard, returned the order and petition to the Board with an endorsement to the effect that the Companies were cheerfully giving a better service than the State saw fit to demand. The order for a petition was then indefinitely postponed.

Baulked of their prey in this particular instance, but still thirsting for "berlud," the Board took up another branch of the gas supply, the result of their deliberations being a determination to "ask the proper tribunal to determine whether or not the manufacture of gas as conducted at the North End is a nuisance to the neighborhood, and whether the health of the residents in the vicinity is endangered thereby." The whole thing savors somewhat of persecution, that has its inception in malice and its fostering in ignorance.

All employees of the Sioux City (Ia.) Gas and Electric Light Company whose duties require them to enter upon the premises of consum-

ers, have been provided with neat silver plated badges; and the consumers have been notified not to permit any one representing himself as an employee of the Company to enter their houses unless he can show his authority for entering in the shape of the badge.

THE works of the El Dorado (Kas.) Light, Heat and Power Company were badly damaged by fire towards the close of last month. The damage is put at $5,000, and the town was without gas or electric lights for several nights.

AT the annual election, Frontier Lodge, F. and A. M., La Crosse, Wis., Brother George McMillan, of the local Gas Company, was, for the third consecutive time, chosen Master.

SUPERINTENDENT TROOP, of the Norwich (N. Y.) Light and Power Company, was treated to an unpleasant surprise the other day, when the retort house roof gave way under the weight of snow deposited on it during the snow storm of Christmas week. He managed, however, to keep the lights up.

MR. GEORGE W. KRAFT, who will be remembered by the fraternity from his proprietorship of the Keystone Iron Works, Philadelphia—a manufacturing concern that was very prominent in the gas works construction line during the decade ended 1874—died recently. We hope to give in due time some account of his life.

ABOUT as queer an accident as has ever been reported in connection with a gas works plant is that which took place in mid-December at Milford, Mass. According to the record, "on December 16th an unmanageable freight car on the Boston and Albany Railroad plunged into the retort house of the Milford Gas Company, breaking through a brick wall, knocking over an 8-foot chimney, and destroying two brick retort arches, causing a damage of about $700.

PATRICK MCKENNA, of New Haven, Conn., a prominent stockholder in the New Haven Gas Company, died at his home in that city on the evening of Dec. 21.

SATISFACTORY progress is being made on the new gas plant at South Framingham, Mass. The holder tank and holder are about completed, and there is no doubt that the works will be given over to the proprietors within the time named in the contract.

WE understand that the grantees of the franchise for a gas works at Huntington, West Va., are not disposed to go ahead under the terms of the agreement. We hope that the differences will be amicably adjusted, for the location would seem to be all in favor of such an enterprise proving fairly profitable.

THE new works of the Worcester (Mass.) Electric Light Company are up to the supply and maintenance of 550 high candle power arcs, and 3,750 (16-candle power) incandescent lamps.

ALDERMAN JOHN FLEMING, of Denver, Colorado, is working with might and main to carry out Mayor Londoner's idea of committing the city to the installation and operation of an electric lighting plant on municipal account. City Treasurer Place also favors the scheme. So far, the trio have figured out that $150,000 will cover the expenditure on plant account, but this looks to be on the scant side. In the midst of all their blusterings, one thing worthy of note is that none of the trio contemplate the utility of using incandescent lights for street illumination. From this unanimity it looks as if Denver, after an extended trial of incandescent lamps as street illuminators, had decided that such a system was valueless for the particular purpose—an opinion which has been formed in every case where it has been tried.

Friction and Lubrication of Journals.

Professor John Goodman points out that the friction per square inch of a journal thoroughly lubricated, and so running upon an oil film, is within limits, independent of the load. The limit is imposed by the pressure which the oil film will bear without being squeezed out and allowing the metals to come into actual contact with each other. At low speeds, however, the friction is greater than at high speeds, and it has been found to decrease gradually till a surface speed of 1,000 feet per minute is attained, when it varies very slightly, being, in fact, practically constant for a considerable range. This is true, however, only for considerable loads per square inch, such as 400 pounds, the area of the journal being estimated by multiplying diameter of shaft by length of bearing.

At loads under 60 pounds per square inch, according to Goodman, the friction gradually *decreases* with a reduction of speed, but when the intensity of the load is greater than this the friction increases when the speed falls below 50 feet per minute. With low speeds a load greater than 60 pounds per square inch seems to squeeze out the lubricant, and so increase the friction. The experiments elicited one interesting fact well known in practice to railroad engineers, namely, the effect of slight side-play in reducing the friction of a journal. A journal with a slight side play, and moving from side to side, has greatly less friction than one in which the side play is entirely taken up. It is, of course, impossible to allow any great amount of side-play to the crank-shaft of a steam engine, but still this fact proves how advisable it is to fit main brasses and connecting rod brasses slightly easy, and explains the heating which is often caused by too good a job being made of the side fit.

A constant load must be less in intensity than an intermittent one: thus a dead load, such as is usually allowed on railroad axles, should not exceed 450 lbs. to 500 lbs. per square inch, while in crank pins, where the load is intermittent, a maximum of 2,000 lbs. per square inch is often applied without heating. On the gudgeon ends, where the sliding velocity of the surfaces is not high, as much as 5,000 lbs. per square inch is allowed. The load, however heavy, takes some time to squeeze out the oil film, and so a heavy load only momentarily applied and then reversed does not get time to bring the metals into actual contact, although a smaller load continuously applied is quite able to do so. The whole efficiency of the journal depends upon its support upon this lubricating film, and the friction is caused, not by the contact of the metal surfaces, but by the continuous work of shearing the oil film existing between those surfaces. According to Goodman's experiments, this oil film measures from 0.0001 to 0.0004 inch thick. It is very interesting to reflect that the efficient working of our great engines depends on a lubricating film of from $\frac{1}{10000}$ to $\frac{4}{10000}$ of an inch thick, and furnishes one more illustration of the minute matters to be examined into before we can be said to understand the simplest actions of those great machines.

It is very customary in engines to oil the bearings from a hole in the upper brass by a syphon lubricator passing oil into grooves, but this, it appears, is bad practice, as the rotation of a journal causes a species of pumping action, which tends to force oil out at that very point. In some experiments it appears that when oil was supplied to the bearing from below, a continual stream of oil was forced up through the oil hole from the grooves, and on stopping up the hole the friction of the bearing at once diminished as much as 25 per cent. When the hole was opened it at once rose again. It may be mentioned that in this case the load on the bearing came upon the upper brass in the same manner as if the upper brass were pressed down by a weight. The closing of the hole caused an oil cushion to be formed under the brass, and so diminished friction. Prof. Goodman, therefore, recommends that oil grooves should not be placed along the line upon which pressure comes. When the pressure comes upon the lower brass, an oil groove in the upper brass is in the proper position, but when the pressure comes on the upper brass this is a bad arrangement.

When the pressure is vertical, as in a horizontal millshaft, the friction is greatly reduced by cutting away the sides of the brass, and the brass in contact gives the best results for minimum wear and friction when the brass width is seven-tenths of the diameter of the journal.

He recommends that brasses should never subtend an angle greater than 90°, the sides being cut away and pads inserted. Pad lubrication is confidently recommended as giving the minimum of friction and oil consumption as well. It consists in applying a woolen or felt pad kept soaked with oil and lightly pressed against the bearing, the supply of oil being kept up by means of lamp cotton, which soaks it up from a reservoir below.

As illustrating the efficiency of this method of working, the following case is given: A new pad weighing 14 drachms was supplied with 2½ oz. of rape oil, and placed in contact with a 7 in. journal; total load on the brass, 4,984 lbs., or 237 lbs. per square inch. At the end of 319,660 revolutions, which is equivalent to 1,239 train-miles, the oily pad was weighed and found to be 1 oz. 2 dr.; hence only 1 oz. of oil had been used. The revolutions per minute were 166; the mean temperature of the journal was 130° F., which rose to 145° at the end of the experiment; the mean coefficient of friction was .010, which rose to .012 at the end of the experiment. This is stated as the best result the author has obtained, but in many similar experiments the equivalent distance was over 1,000 miles.

In conclusion, the results of Prof. Goodman's experiments seem to point to clearing away brasses, except at surfaces in line of pressure, limiting angular arc to 90° and introducing oil at the gaps by pads. A gas engine, whose bearings had been altered in the manner indicated, recently gave a mechanical efficiency of 90 per cent., which is very remarkable for a gas engine which has only one impulse for two revolutions.

ENGAGEMENT DESIRED.

A Superintendent, having full management of a coal gas plant with a daily sendout of 200,000 cubic feet, is desirous of making an engagement. Will be open for proposals from this date. As a manager he has full experience. Is a good business man and has good executive ability. All communications should be addressed to "K.," care this Journal.

Situation Wanted,

As Superintendent of Gas, Water, or Electric Light Works,

By a man of 20 years' experience in the manufacture and distribution of gas and the construction and extension of gas plants. Can give the best of references. Address

812-4 "D. D.," care this Journal.

FOR SALE,

Valuable Gas and Electric Light Plant,

In a flourishing Ohio city of 12,000. Franchise perpetual. Earnings, $22,000 per annum, and may be largely increased. Address

810-5 "FABYAN," care this Journal.

Dissolution of Co-Partnership

The firm of CONNELLY & CO. is this day dissolved by mutual consent, J. S., T. E., and J. W. Connelly retiring, and S. F. Hayward continuing the business, incorporating under the name and style of the "CONNELLY IRON SPONGE AND GOVERNOR CO.," assuming all liabilities of the late firm, and authorized to collect all outstanding accounts.

J. S. CONNELLY,
T. E. CONNELLY,
J. W. CONNELLY,
S. F. HAYWARD.

The retiring members take this opportunity to thank their many patrons for the liberal patronage they have enjoyed, and would respectfully solicit a continuance of the same for the new Company, bespeaking for them an earnest desire to please in all their dealings.

J. S. CONNELLY,
T. E. CONNELLY,
J. W. CONNELLY.

We should be pleased to receive a continuance of the favors extended to the old firm, and hope, by a vigorous, energetic pushing of the business and fair dealing, to deserve it. Thanking you in advance,

CONNELLY IRON SPONGE AND GOVERNOR CO.

December 1, 1890. 812-6

CALIFORNIA GAS WORKS For Sale.

Several Coal Gas Plants, in both Southern and Northern California, now profitably operated and constantly increasing in value. Practical gas men, with $7,500 to $15,000 to invest, can secure controlling interest and superintendency. Very desirable places of residence. Satisfactory reasons for selling.

"SECRETARY," 123 Beale Street,

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The American Gas, Light & Heat Co.,

OF

249 S. 6th St., Phila., Pa.,

Are now prepared to erect plants of their Oxy-Hydrocarbon Process, to carburet coal gas up to any given or named candle power required for general consumption (for instance, from 20 to 25 candles), and at a cost not to exceed one and three-quarters (1¾) cents per candle power per 1,000 cubic feet increased, with a permanent and perfectly *fixed* gas, *not a vapor*—a gas that will whiten the whole output of the works.

This gas can be furnished at a cost less per 1,000 cubic feet than the coal gas may be costing the company.

Our system is such that we can furnish plants that will carburet 50,000 cubic feet in 24 hours, or three or four million feet in the same length of time. *One* of our large benches or plants would be capable of generating 100,000 cubic feet of gas in 24 hours, which would raise the candle power on 2,000,000 feet (taking as a standard coal gas at 15 candles) 3 candles on the 2,000,000 feet, enabling the works to deliver to consumers an 18 candle gas; or, enlarging our plant, the candle power may be increased as desired, at the same cost per candle power, less interest on plant.

This is much less per candle power than it can be furnished by the use of cannel coal or by vaporizing naphtha. With our process we improve the whole output in color—viz., whiten the flame with the oxygen, as well as furnishing a *thoroughly fixed* gas, and no possible danger of separation as there is with vapor. Correspondence solicited.

J. J. NEWELL, Sec'y.

September 4, 1890.

Coal Tar For Sale.

PROPOSALS for the entire make of Coal Tar at works of **Knoxville (Tenn.) Gas Light Company,** for five (5) years, the same being about 60,000 gallons per year, will be received at the Company's Office in Knoxville, Tenn. Tar to be delivered in tank cars at works. Not more than 20,000 gallons shall be allowed to accumulate in well at any one time. Right to use sufficient tar for Company's own purposes, and to reject any or all bids, reserved. The Company expects bids in the neighborhood of the price which other Companies are now receiving—viz., 10 cents per gallon.

KNOXVILLE GAS LIGHT CO.,

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"SUCCESSFULLY INTRODUCED."

Hill Chemical Company's IRON MASS

For Gas Purification.

Office, 229 Bridge Street. Works, Newtown Creek.

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Analyses of Gas, Fuel and Gas Coals, Crude and Refined Petroleum, Materials for Gas Purification, Tar, Ammoniacal Liquors and other Bye-Products, Fire Clays, Deposits in Mains, Water for Steam Making, Boiler Scale, etc., etc. Expert work in connection with "Damages to adjacent water supplies and adjoining properties." Experimental Investigations for Inventors.

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The Cheapest Gas Generating System in the World.

Utilizing any Kind of Low-Priced Coals.

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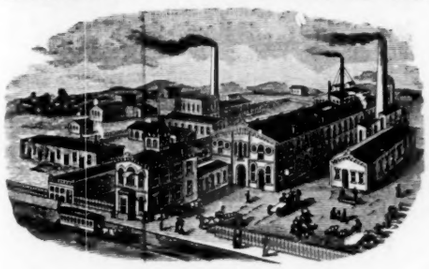

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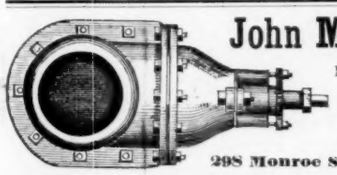
Hydraulic Main Dip Regulators, also Check Valves, Foot Valves, Yard-wash and Fire Hydrants. Send for Circulars.

Valves.—Double and Single Gate, ¼ in. to 48 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, and Oil. Send for Circulars.



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FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

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These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

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Fuel and Its Applications.

By E. J. MILLS, D.Sc F.R.S., and F. J. ROWAN, C.E., assisted by others, including Mr. F. P. Dewey, of the Smithsonian Inst., Wash., D. C.

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THE DYNAMO HOUSE
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Showing the
IRON TRUSSES, IRON TRAVELING CRANE,
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GENERAL ARRANGEMENT OF THE BELTS.

The building is 60 feet wide by 200 feet long, and running lengthways the entire length of the building is a traveling crane for the purpose of raising and lowering the machinery in position. This building is pronounced the most complete Electric Light Station anywhere in the country.

WRITE TO US FOR PLANS AND ESTIMATES FOR THIS CLASS OF WORK.

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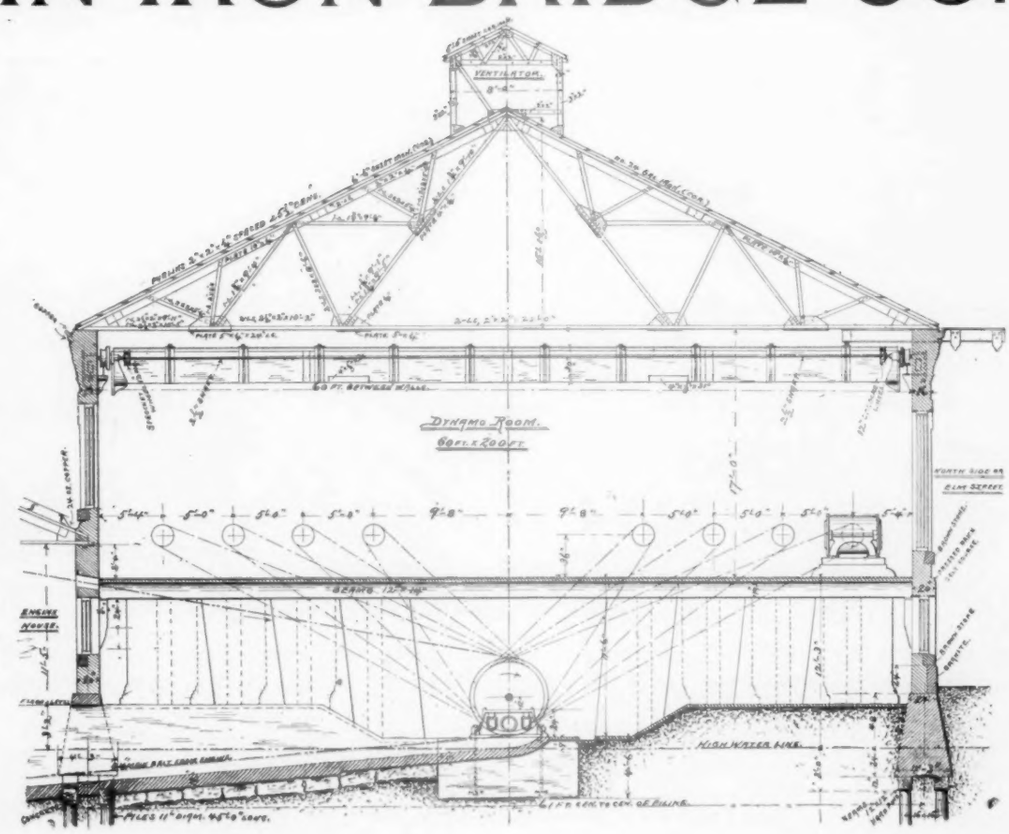

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Take 10th or 23d Street Ferries from New York to Greenpoint. **BROOKLYN, N. Y.**

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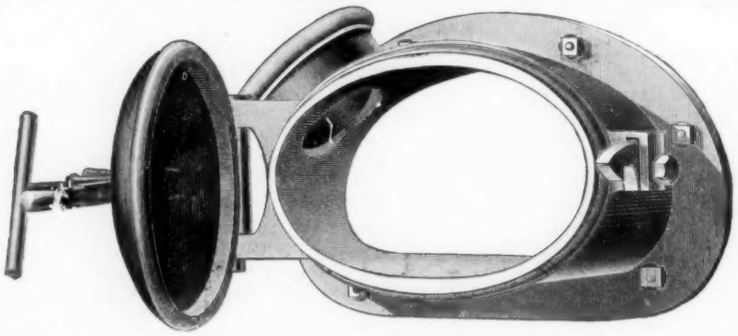

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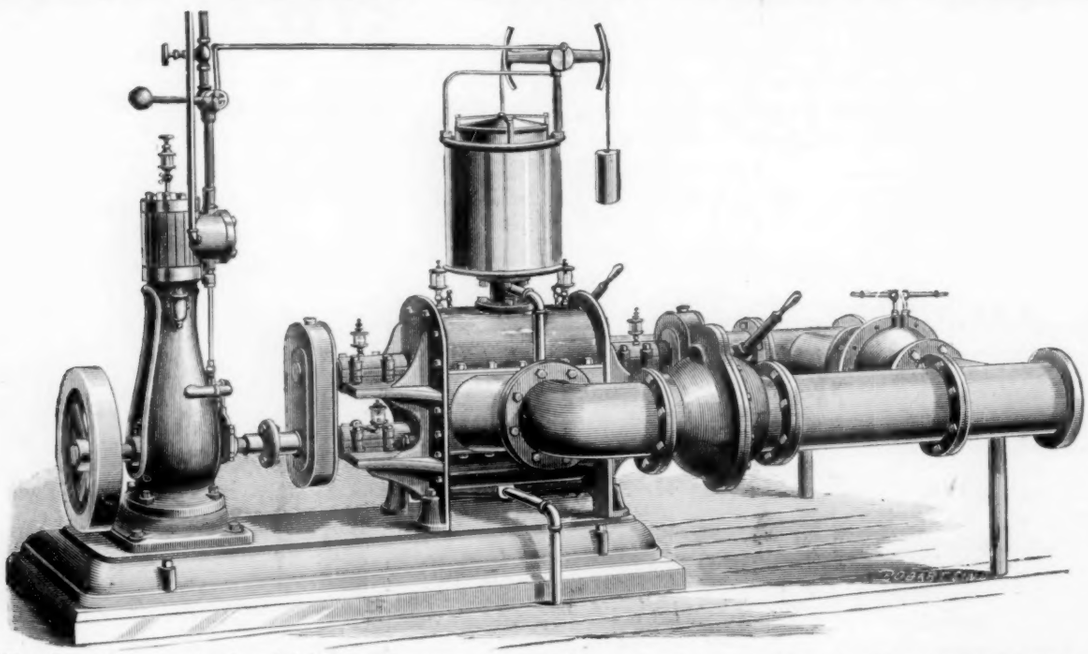

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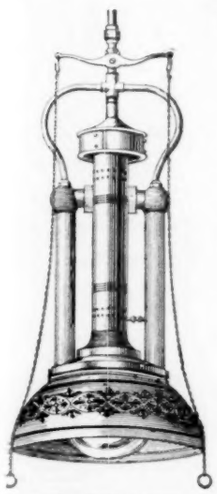

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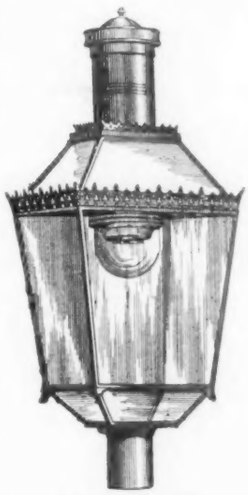

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WELSBACH SYSTEM
OF
Incandescent Gas Lighting.

OFFICE, DREXEL BUILDING, PHILA., PA.

At the Fall Session of the Board of Supervisors of Winnebago County, held at the County Court House, Oshkosh, Wis., Nov. 26, 1889, the report submitted by Mr. C. W. Cook, Chairman of the Committee on Public Buildings, recommending the use of the Welsbach Incandescent Gas Burner in the Buildings under their charge, was unanimously adopted, because of the extreme economy in the consumption of Gas and the superior character of the light obtained.

MOSES G. WILDER, MECH. ENGR.

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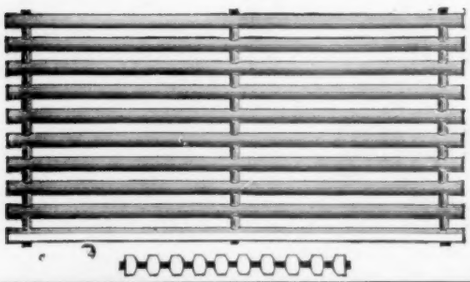

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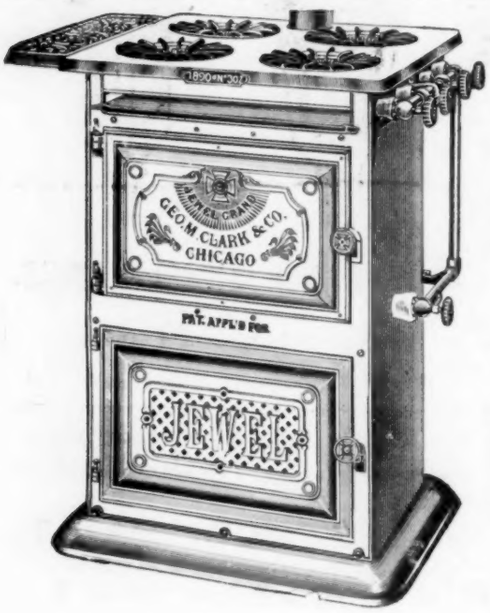

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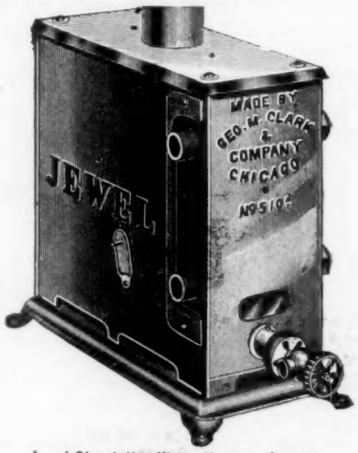

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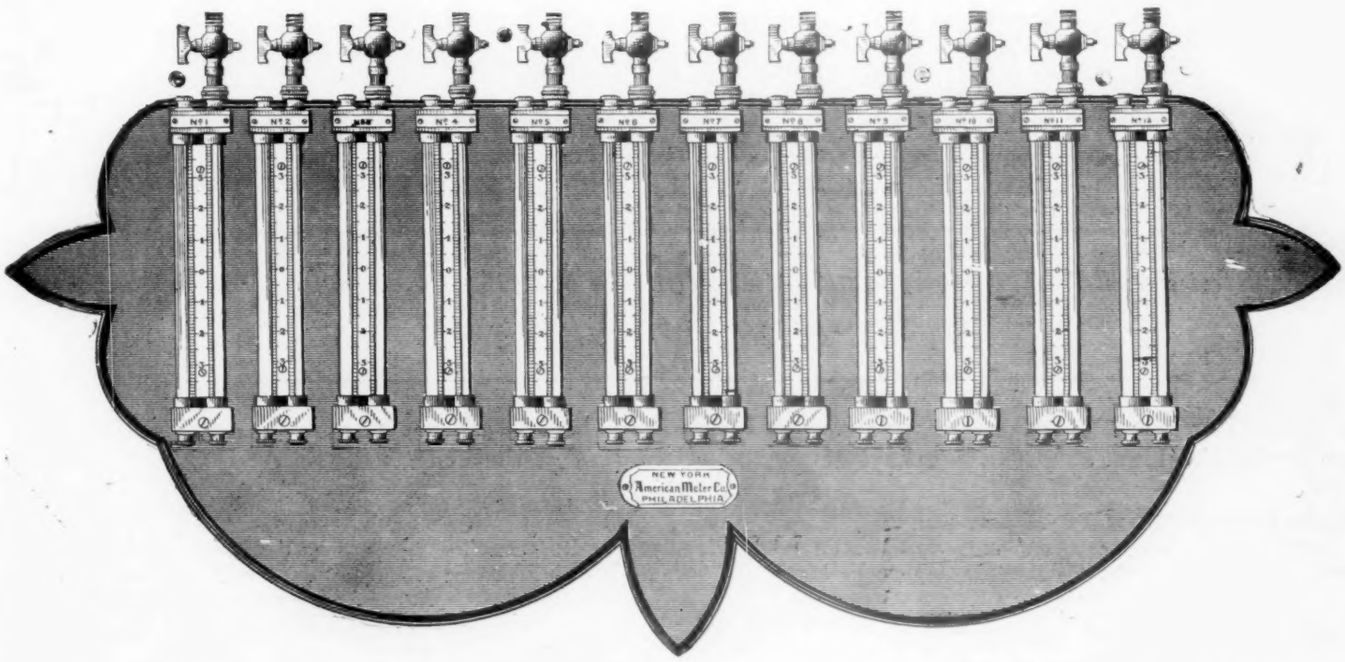

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THE GAS LIGHT AND COKE COMPANY, HORSEFERRY ROAD, WESTMINSTER, Nov. 25, 1889.

MESSRS. KIRKHAM, HULETT & CHANDLER, LIMITED:

Gentlemen—In reply to your inquiry respecting the result of putting Wooden "Bundles" into some of the Washer-Scrubbers at our Beckton Station, I beg to say that they have answered admirably for the few months they have been in, and I think them a decided success.

I am yours truly, (Signed) G. C. TREWBY.

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NOTE.—The first Washer-Scrubber referred to in the above letter was fitted with improved "Bundles" in May, 1888, and these have proved so satisfactory that the Gas Light and Coke Company have had several other "Standards" fitted in the same manner, and have recently given an order for machines for 6,000,000 cu. ft. per day.

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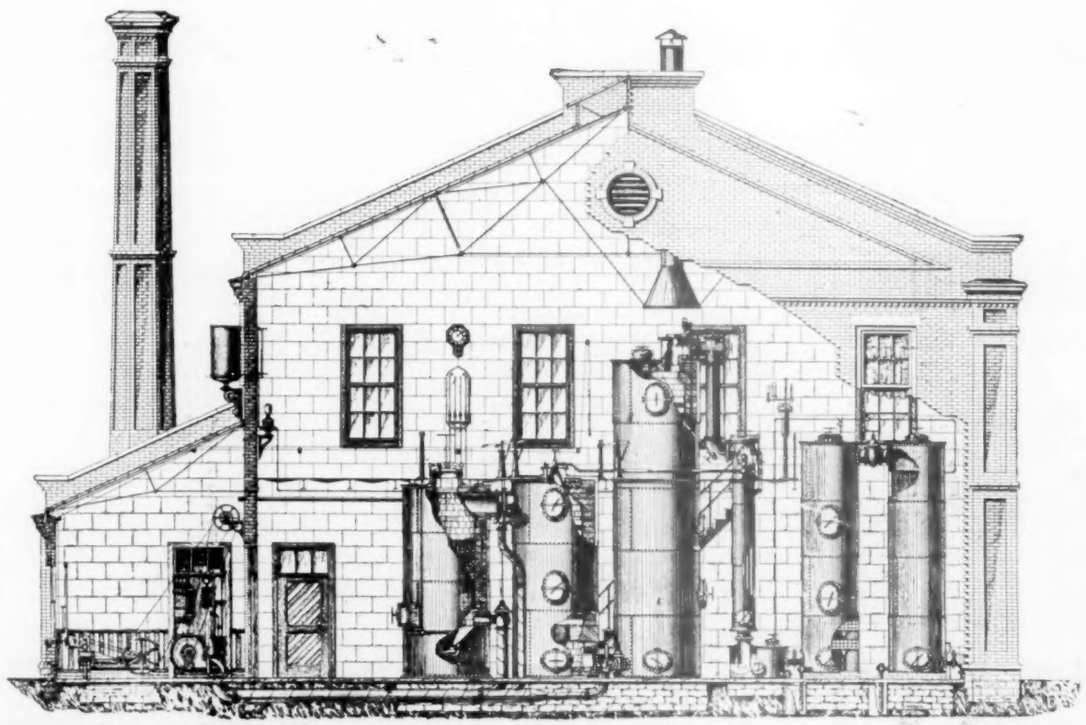

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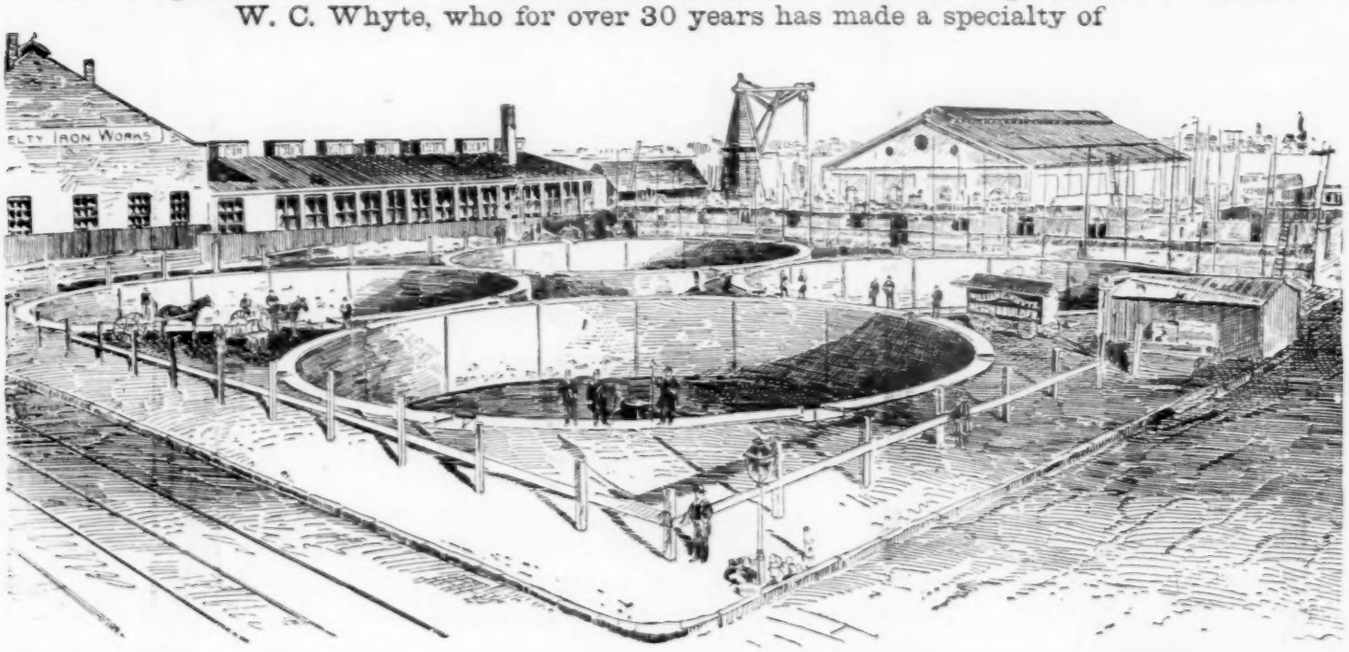

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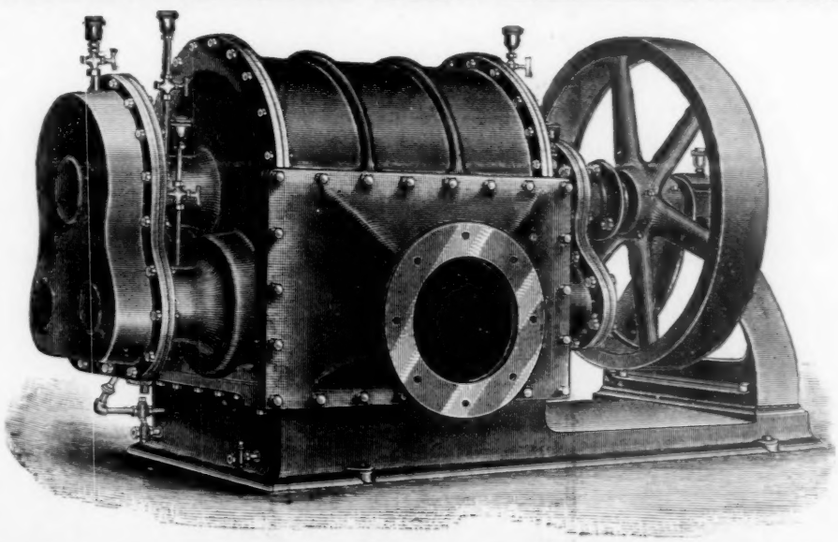

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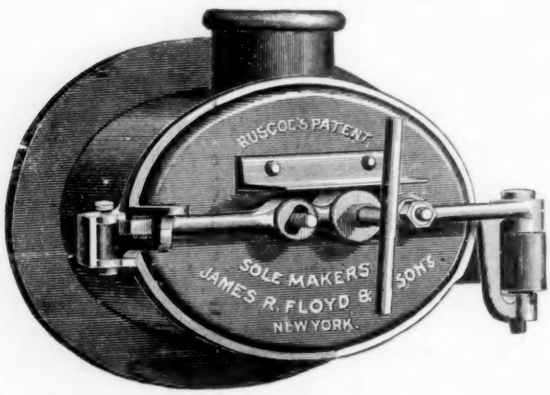

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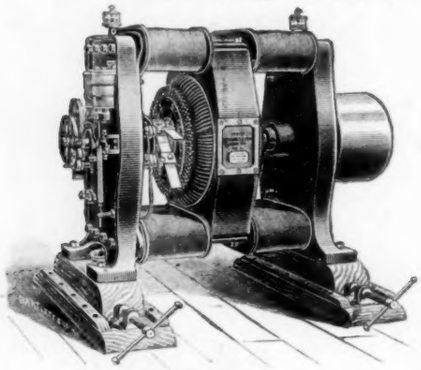

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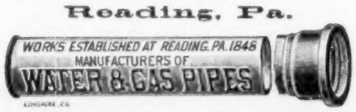

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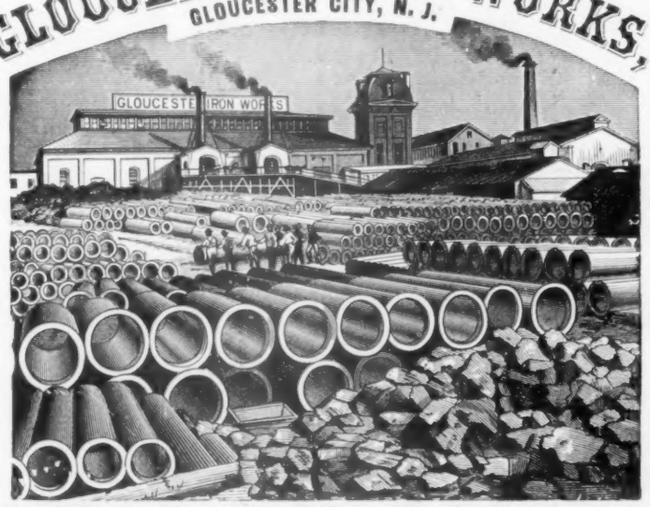

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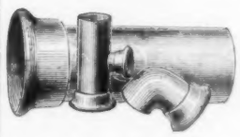

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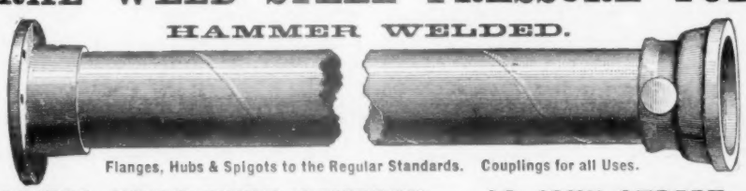

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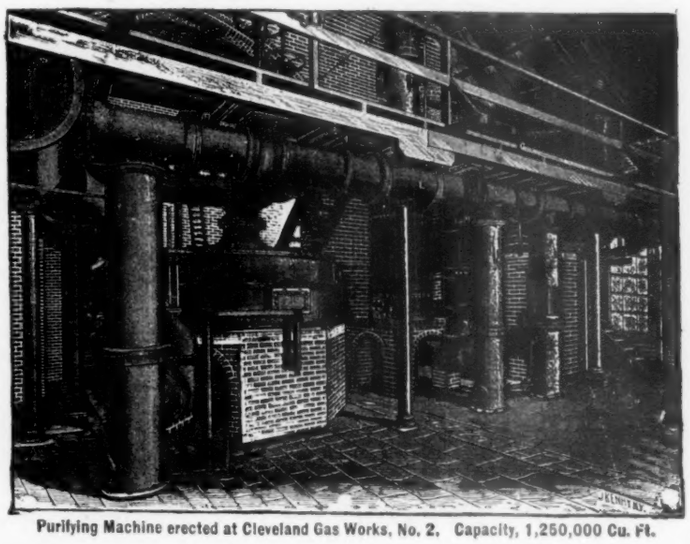

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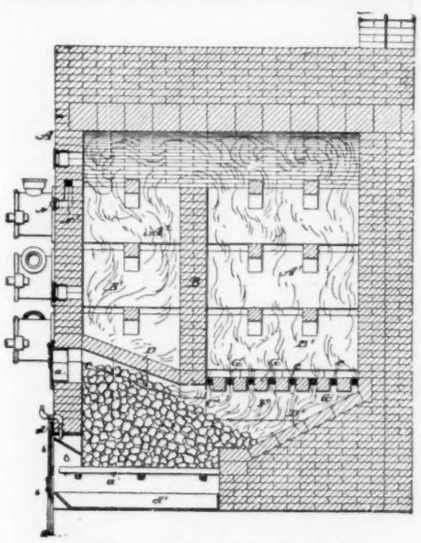

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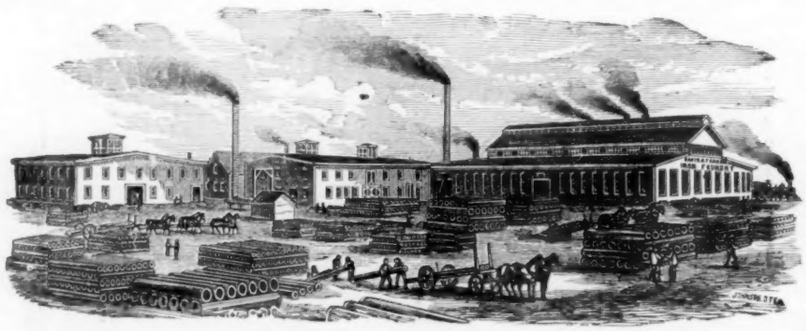

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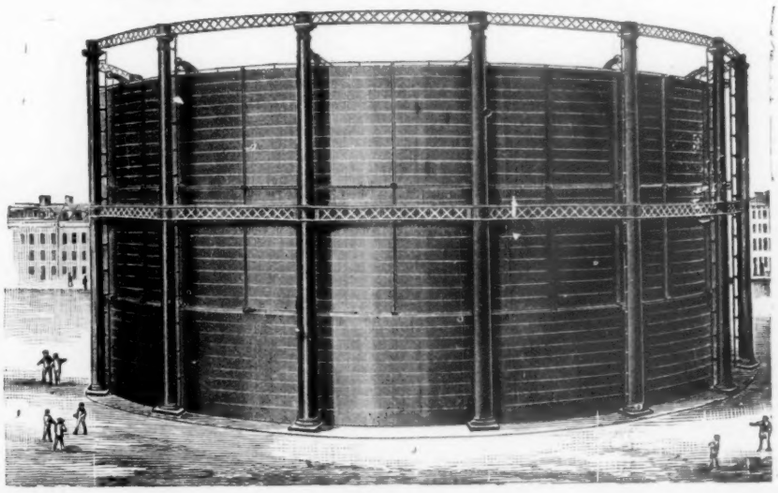

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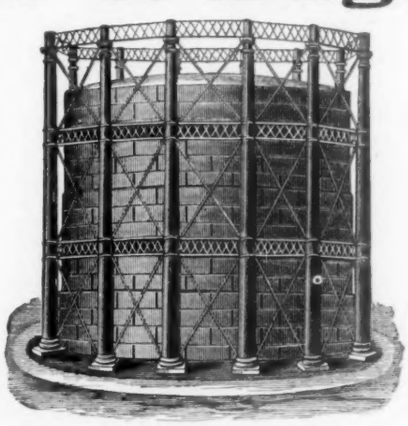

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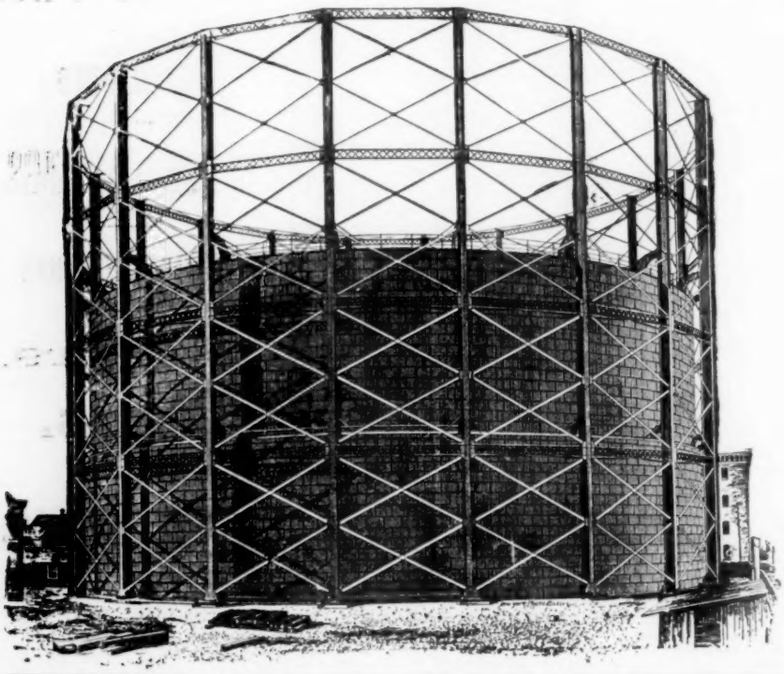

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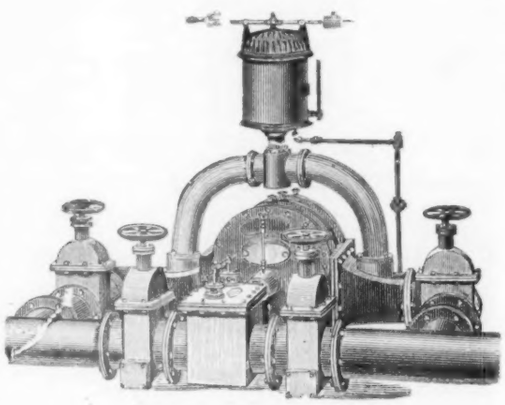

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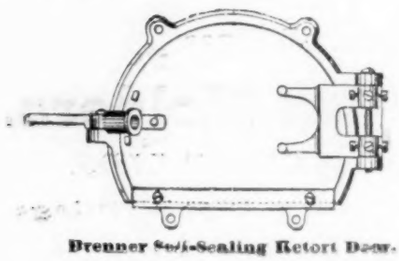

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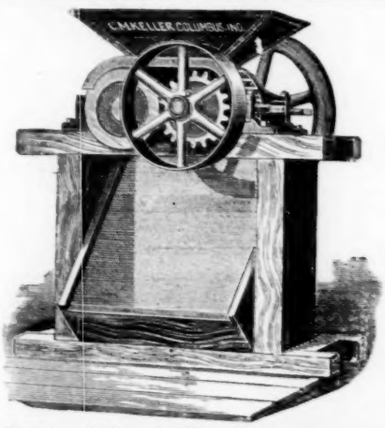

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GAS METER MANUFACTURERS,

(Established 1854.)

51 Lancaster St., Albany, N. Y. 34 & 36 West Monroe St., Chicago, Ill.

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS, PRESSURE GAUGES, ETC.

Also STAR GAS STOVES, RANGES, and HEATING STOVES.

We use only the very best materials, and employ the most skilled labor, and by our long experience (36 years) and personal supervision of every detail, we feel justified in assuring the public that our goods will give perfect satisfaction. Every Meter emanating from our establishment will bear the State Inspector's Badge, and will be fully warranted by us. Our Annual and Calendar will be sent to Gas Companies upon application.

WM. WALLACE GOODWIN, President. E. STEIN, Vice-President. H. B. GOODWIN, Sec. & Supt. G. P. EDWARDS, Mang'r, New York. S. S. STRATTON, Mang'r, Chicago.

THE GOODWIN GAS STOVE AND METER CO.,

1012, 1014 & 1016 Filbert St., Phila., Pa. 113 Chambers St., N. Y. City. 44 & 46 Dearborn St., Chicago, Ills.

Agents, WALDO BROTHERS, 88 Water Street, Boston.

SOLE MANUFACTURERS OF THE

"SUN DIAL" GAS STOVES,

The Most Economical, Efficient, and Durable Gas Stove Made.

GAS COOKING STOVE, No. 8 C.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves.
37 in. high.	12 in. high.	12 in. high.	24 in. long.	36 in.
20 in. wide.	17½ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.

Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.

The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crosspieces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast-iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves.
31 in. high.	9½ in. high.	10 in. high.	21 in. long.	32 in.
17 in. wide.	14½ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated.

"RADIANT" BOILING STOVE, WITH REGENERAT[illegible]ER.

Size, 6¼ inches diameter, 8 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.

Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.

½ in. supply pipe should be used where the pressure is 1 in. or over.